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# JOURNAL OF MAMMALOGY

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# THE DUSKY-FOOTED WOOD RAT (NEOTOMA FUSCIPES)

BY PENNOYER F. ENGLISH

[*Plates 1–3*]

While at Oregon Agricultural College, Corvallis, Oregon, the writer undertook an ecological study of the dusky-footed wood rat (*Neotoma fuscipes* Baird), the results of which are presented herewith. The material was all taken and the observations made within twenty miles of Corvallis. These observations consist of studies of the rat both in the field and in the laboratory.

The writer wishes to acknowledge the advice and assistance of Professors Howard M. Wight and George F. Sykes, of the Oregon Agricultural College. He is also under obligation to George Orr, who was very kind in leading him to communities where many rats were found.

Wood rats are for the most part nocturnal, but the writer has occasionally observed them collecting food and otherwise active in the day time, showing a tendency toward diurnal habits.

## NESTING

The dusky-footed wood rat lives in nests built of sticks, twigs and small fallen limbs, pieces of bark, and almost anything the animal is able to handle. Such materials as bones, the neck and skull of a dog with chain attached, cans, glass, old shoes, rubbers, and wire have also been found in the nests.

The nests may be built in fir trees, *Pseudotsuga taxifolia*, or on the ground among these trees; on brushy hillsides, or in low lands where there may or may not be overflow. They have also been found along

a main road, built in old apple trees, *Malus rivularis*, and on old rail fences, this latter location being quite common. In many cases, nests have been found near running water, sometimes even being built directly over a small stream, in other cases they have been found a mile or more from water.

In most instances the nests are built in very inaccessible places, in thorny thickets of rose briar, hawthorne, blackberry, and thick brush, and also where there is an abundance of poison oak. Some nests have been found surrounded by nettles.

The nests vary considerably in size, ranging from two to eight feet both in height and diameter, and are constructed in a conical form.

In making an extensive study of the nest-building habits of wood rats in this locality, my conclusion based on two years' work is that the rats of the succeeding generations use the nest of their parents, each year adding more material on to the old nest. For this reason we sometimes find very large nests in isolated places. However, if the colony increases rapidly, conditions will be too crowded for all to live in the same nest, hence we find newer, smaller nests under construction and the springing up of a large colony of nests in a given community.

The large nests described above are divided into as many as five compartments, these being used as nursery, living room, and storage chambers; and one place is used for the depositing of dung. The inner compartments are connected by a series of runways, making communication simple. All of these compartments have exits to the outside, and if one prods the nest with a stick, one may see the rat first at one place, then at another. With the exception of the dung chamber, these compartments are always well kept and clean, being lined with grass, shreds of bark, and moss. In many cases the feathers of birds are used, as feathers of the robin and Chinese pheasant have been observed. Wood rats inhabit old residences in many cases, making use of wall paper, lace curtains, and anything else that may be suitable. In one such instance the silk lining of a hat was found lining the living compartment of a nest located in an old barn.

Under some nests one may find a runway, rarely more than twenty inches in length, leading into the ground, and used as a hiding place.

Entrance to the nest is gained by the various openings already described, some being high, some low, and others on a level with the ground. In many instances the rats make use of hollow logs and branches which lead to the center of the nest from the outside, sometimes

five to fifteen feet distant. These act not only as routes of entrance or exit but also as means of protection from enemies during such travels.

In captivity the wood rat behaves very much as it does in the open, usually building an elaborate nest as material at hand permits, and according to the same plans as described above. It also keeps adding to the nest by putting such twigs and leaves as are not used as food on the top of the nest. If one disturbs the nest or destroys it the rats immediately look over the situation and set to work to rebuild, sometimes changing the position of the living compartment from one side to another. Three rats, one male and two females, were kept in a cage from March 7, 1921, until August 15, 1921, and were under observation day and night. The three lived together harmoniously, sleeping side by side in the same compartment, and were found to be most active after a light warm shower.

On one occasion, as an experiment and a test of behavior, the writer tore up the nest and, as the rats were busy rebuilding, one rat was noticed cleaning out the living compartment of all little sticks and debris that had found their way in when the nest was destroyed. This rat was observed to carry a stick one-half inch in diameter and three inches in length out of the living den and to deposit it outside the nest. This same stick was replaced in the chamber from which the rat had just removed it, whereupon the rat promptly removed it again. This was repeated twelve times, the rat each time putting it on the outside of the nest. How long this might have kept up is a question, as the rat was, seemingly, as persistent as was the experimenter.

Besides large conical nests found on the ground, other nests of considerable size are often found built in trees, at a height of from four to twenty-five feet above ground. There seems to be no particular rule followed in selecting a tree in which to build, as nests have been observed in oak (*Quercus garryana*); fir (*Pseudotsuga taxifolia*); apple (*Malus rivularis*); maple (*Acer macrophyllum*); willow (*Salix lasiandra*); and hawthorne (*Crataegus douglasii*). In many instances the same family of rats have one nest on the ground and another in a nearby tree, which they use at different times. Nests destroyed in the field are seldom rebuilt; only one instance of rebuilding has been noted.

## FOOD HABITS

The diet of wood rats varies, and one gets a fair idea of what they eat by an examination of the different materials found in a fresh condi-

tion in the nests. The animals cut off the ends of branches, leaves or blossoms of various trees and shrubs. These cuttings they collect and take to the nest. Being herbivorous animals, they subsist on a great variety of green vegetation, including grasses, leaves, fresh fruits, small bulbs, bark and flowers. Dry fruits such as maple seeds and others have been found in large amounts in several nests, as well as hazel nuts and acorns. A summary of these stored foods is appended.

After careful study of nests and stored foods of the dusky-footed wood rat, involving an examination of the contents of sixty-three nests, it was found that some nests contained as many as one hundred and thirty-two cuttings of fresh materials; these included fourteen varieties of plant species. In one nest were found ninety-five cuttings of sixteen varieties; in another eighty-three cuttings of five varieties. This material was all fresh and probably comprised one day's supply, as seldom are dried cuttings found unless the nest has been deserted.

Besides the stored shrubs and green foliage, where the nests were located near maple trees we found maple seeds stored to the surprising amount of a full bushel in a single nest. In one instance a nest twenty feet from the ground contained no less than six quarts of maple seeds. Acorns and hazelnuts along with fruit-pits of prune, plum, and cherry also occurred.

The wood rats are very particular about their food. For example, when you bring in a variety of fresh cuttings and proffer one to a rat, if the food does not suit its fancy it will not touch it. However, if one bites off a twig and starts eating, the others, on hearing one of their number eating, will promptly do likewise. At times they will cut off a twig and carry it to the nest, to eat it in seclusion, and then come back for more. Again they will remain near the supply and eat until they are satisfied, holding the material in their front feet and eating all they have cut off before attacking more, thus there is little waste of green succulent material. It is impossible in fact to induce them to take more than they can hold in their front feet. Occasionally they fight over the food; such a brief disturbance may occur if one rat is eating and another rat steals his supply; a brief chase and a momentarily ruffled temper ensue.

The following is a list of foods found in an examination of sixty-three wood rat nests, showing the number of times each has been observed by the author.

| COMMON NAME | SCIENTIFIC NAME | OCCURRENCE |
|---|---|---|
| 1. Domestic Apple | *Malus* sp. | 37 |
| 2. Maple seed | *Acer macrophyllum* | 26 |
| 3. Crabapple | *Malus rivularis* | 23 |
| 4. Snow Berry | *Symphoricarpos albus* | 21 |
| 5. Willow | *Salix lasiandra* | 21 |
| 6. Wild Rose | *Rosa gymnocarpa* | 14 |
| 7. Douglas Fir | *Pseudotsuga taxifolia* | 12 |
| 8. Wild Currant (flowering) | *Ribes sanguineum* | 12 |
| 9. Oak | *Quercus garryana* | 11 |
| 10. Hazel Brush | *Corylus californica* | 9 |
| 11. Acorns | *Quercus garryana* | 9 |
| 12. Fern (Bracken) | *Pteridium aquilinum pubescens* | 8 |
| 13. Chittum | *Rhamnus purshiana* | 8 |
| 14. Wild Gooseberry | *Ribes lacustre* | 7 |
| 15. Hawthorne | *Crataegus douglasii* | 7 |
| 16. Hazel nuts | *Corylus californica* | 7 |
| 17. Oso-berry | *Osmaronia cerasiformis* | 6 |
| 18. Ash | *Fraxinus oregana* | 5 |
| 19. Water leaf | *Hydrophyllum* sp. | 4 |
| 20. Service Berry | *Amelanchier alnifolia* | 4 |
| 21. Poison Oak | *Rhus diversiloba* | 3 |
| 22. Wild Cherry | *Prunus demissa* | 3 |
| 23. Parsley | *Sanicula* sp. | 3 |
| 24. Vine Maple | *Acer circinatum* | 3 |
| 25. Douglas Fir cones | *Pseudotsuga taxifolia* | 3 |
| 26. Wild Blackcap | *Rubus macropetalus* | 2 |
| 27. Nine Bark | *Opulaster opulifolius* | 2 |
| 28. Salmon Berry | *Rubus spectabilis* | 2 |
| 29. Broad Leaf Maple | *Acer macrophyllum* | 2 |
| 30. Laurel | *Arbutus menziesii* | 1 |
| 31. Camas | *Quamassia leichtlinii* | 1 |
| 32. Solomon Seal (False) | *Vagnera amplericaulis* | 1 |
| 33. Wild Geranium | *Geranium oreganum* | 1 |
| 34. Vetchling | *Lathyrus polyphyllus* | 1 |
| 35. Dogwood (Flowering) | *Cornus occidentalis* | 1 |
| 36. Dock | *Rumex mexicanus* | 1 |
| 37. Poplar | *Populus trichocarpa* | 1 |

## BREEDING

So far as the author has been able to determine the female mates with a single male and there is no evidence of polygamy. After mating, the male becomes a hermit and lives alone in a separate nest which he constructs himself. This nest is small and usually built in a tree.

This was the case in all my observations with the exception of one instance, where male and female were found in the same nest, but in different compartments. The mother gave birth to three young the day following the observation.

Wood rats bring forth their young in the spring, from February to May. The mother is equipped with four mammary glands, which are squarely placed and in the same relative position as on our domestic cow. This is in contrast to the condition found in the common brown rat, which has as many as fourteen mammary glands. In my study the average number of wood rats was found to be 2.8 per litter, while the brown rat may have from ten to fourteen young at one time.

*Table Showing the Number of Embryos and Young*

| DATE | LOCALITY | EMBRYOS IN UTERI | YOUNG BORN |
|---|---|---|---|
| March 12 | Corvallis | | 3 |
| March 22 | Sulphur Springs | 3 | |
| March 22 | Sulphur Springs | 3 | |
| March 22 | Sulphur Springs | | 3 |
| March 22 | Corvallis | | 3 |
| April 3 | Philomath | 2 | |
| April 4 | Corvallis | | 3 |
| April 15 | Corvallis | | 2 |
| April 18 | Corvallis | | 3 |
| April 18 | Corvallis | | 3 |
| Total | | 8 | 20 |

Summary:

| | |
|---|---|
| Female rats examined | 10 |
| Female rats pregnant | 3 |
| Total number of embryos | 8 |
| Female rats with young | 7 |
| Total number of young rats | 20 |
| Average in litter | 2.8 |

Seventeen days after birth the young open their eyes, and weaning takes place at approximately three weeks of age. After weaning, the young, by example of the mother, begin to eat the same green foods, and soon become quite adept at handling the food with their front feet.

In captivity they seem to act the same as when out in the open; for example, if the nest is disturbed, the young dart out in one direction,

the mother in the opposite direction. The young will hide under anything they can find about the nest. The mother will try to keep the intruder away and will bite if she gets a chance.

A very interesting observation concerning the mother and young was that the suckling young were constantly attached to the mammary glands of the female until the time of weaning. Whenever the mother is disturbed she leaves her nest with the young attached to her, and in all her maneuvers about the cage and in nature, the young remain attached to her mammary glands.

When one approaches a mother rat carrying the young in the manner described above, she endeavors to hide, but is not in the least bit cowardly and will try to bite if one gets close enough. The bite is sufficiently severe to draw blood. If a stick is put in front of her, she will push it out of her way, using her front feet and her mouth, at all times being careful of the young.

Another way of protecting the young is for the mother to hover over them, young still attached, in a way similar to a hen with her chicks. The mother is very cleanly and if she or the young get dirty in going about outside the nest she will immediately begin washing both herself and the young. At times a female has been observed to lie on her side to permit the young to suckle.

In order to observe the behavior of male toward male, two males were placed together in the same cage, the following observations being recorded: One made a rush at the other, trying to bite; then rushes were exchanged, followed by a wriggling and a beating of the tail on the bottom of the cage, producing a noise that could easily be heard ten feet away. This was accompanied by an opening and shutting of the mouth so that the clicking of the teeth could be heard distinctly.

Apparently, the wood rats do not breed readily in captivity, as two females and one male were kept together in the same nest from March 7, 1921, to August 15, 1921, neither female showing any signs of pregnancy.

## ECOLOGICAL ASSOCIATIONS

During the course of the field work, on five different occasions skunks (*Mephitis*) were found either in or about wood rat nests. On one occasion a photograph was obtained of a skunk in a wood rat nest, where it had made its home. This animal was pregnant and contained four embryos. The wood rats had entirely disappeared from this locality, due perhaps to the moving in of the skunks. Other instances

have been observed where skunks were found living at the bottom of a hollow tree and wood rats nesting in the tree above. On still another occasion feces of the skunk were found on the ground under a large nest, showing that the skunk had wintered there.

Other animals, as brush rabbits (*Sylvilagus*) and jack rabbits (*Lepus californicus*) have been observed in the same locality, as well as native grouse (*Dendragapus*) and Chinese pheasants (*Phasianus torquatus*). On three occasions dead moles (*Scapanus townsendi*) have been found near wood rat nests.

Woods rats harbor ticks, mites, and fleas, but not in large numbers. On two occasions lepidopterous larvæ (species not yet determined) have been found in the damp bottom of the nests. These larvæ failed to develop "in captivity."

Wood rats occasionally use the nest of the crow (*Corvus caurinus*) as evidenced by the presence of dung of rats in these nests, especially when these nests were in trees above a rat community.

The nest of a wren (*Salpinctes obsoletus*) has also been found located in a wood rat nest that was inhabited, the wood rat nest being built over a decayed fir log and in a fir thicket, the wren's nest being built in the old log within the wood rat nest.

The enemies of wood rats are skunks, snakes, hawks, owls and wild cats; these animals, together with man, tend to keep the numbers of wood rats in check.

MEASUREMENTS

| | TOTAL LENGTH | TAIL | TARSUS |
|---|---|---|---|
| Average measurements of 8 adult females | 385.85 | 187.14 | 36.71 |
| Average measurements of 7 adult males | 443.75 | 215.99 | 41.12 |
| Average of 15 adult males and females | 416.73 | 202.46 | 39.06 |

GENERAL CONCLUSIONS

The wood rats of the species *fuscipes*, although found on hillsides, generally select small valleys and live very close to small streams of water. They almost invariably live in communities of scrub oak, *Quercus garryana*. However there is no hard and fast rule as to this.

In most cases the rats live in colonies of from three to fifteen or more nests, and seem to be familiar not only with their own nest but also with the other nests in the colony. A rat chased out of his own nest

GROUND NEST OF NEOTOMA FUSCIPES

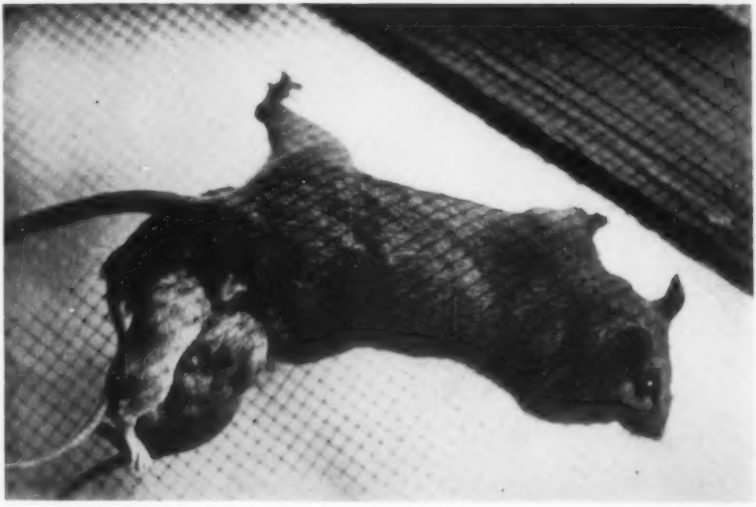
This nest is six feet high, and is built among willows, hawthornes, and wild roses.

(English: Dusky-footed Wood Rat.)

TREE NEST OF NEOTOMA FUSCIPES

This nest is three feet high and three feet wide, and is built in a wild crabapple tree.

(English: Dusky-footed Wood Rat.)



FEMALE NEOTOMA FUSCIPES WITH YOUNG

The upper figure shows the frightened mother, with three young attached, on the side of the cage.

(English: Dusky-footed Wood Rat.)

will run to another nest in the same colony and, if disturbed again, to another, showing, at least, that it must have been to these places before.

We find them most often near streams, because of the fact that a large amount of their food grows there.

*Agric. and Mech. College of Texas, College Station, Tex.*

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## FEEDING HABITS OF MOLES[1]

By Frederick L. Hisaw

Since the mole was first known to scientists, it has been considered a carnivorous animal. This opinion has been supported chiefly by data obtained from examination of stomach contents. These investigations showed that animal remains formed the greater bulk of the substances in the stomach, but, at the same time, some vegetable matter was also found. The majority of the investigators contended that the plant materials were eaten accidentally, and that the damage done to plants was due to the method of digging and to mice, which are known to frequent the mole's burrows. On the other hand, a few investigators have pointed out that starchy materials and seed coats of certain grains have been found in the stomach, and they have expressed the opinion that moles find certain vegetable materials an acceptable addition to their worm and insect diet. The great majority of the data from which deductions have been made concerning these points have been gathered in the field, and the fact that these studies have not completely settled the question of food preferences is evinced by numerous, contradictory opinions of laymen, and even scientific men.

Even though the general economic status of the mole has not been established its objectionable activities in gardens and lawns have made it necessary to eliminate it from these places. The most practical and economical method of control for most animals is to poison them, but until the food habits of the mole are definitely known, it would be difficult to formulate a poisoned bait. Comparatively little study has been made of captive moles under laboratory conditions that were suitable for conducting carefully controlled feeding experiments. In

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view of the insufficient data and contradictory opinions on the food habits of the mole and of its economic importance, it seemed desirable to investigate these problems more fully. For assistance in field and laboratory work the writer wishes to acknowledge his indebtedness to Messrs. Percy L. Depuy, Fred E. Emery, and W. F. Law.

Moles do not adapt themselves readily to laboratory conditions. They become very nervous and usually worry themselves to death. Scheffer ('10) states that he had over a score of moles in captivity and all died within two or three days with the exception of one, which lived nearly two weeks. Dr. James E. Ackert of the Kansas State Agricultural College informs the writer that he was able to keep moles in captivity for as long as five months. Considerable difficulty was experienced and much preliminary work was required to perfect laboratory conditions under which the animals would live.

The methods followed in these experiments were chiefly of a laboratory nature. A basement room was selected for a laboratory. This furnished a cool, damp situation, which was found necessary if the animals were to live in captivity. Most of the moles used in the experiments were captured by small boys, who took them uninjured in gardens after a rain and received a small fee for them.

It was found that a wooden box three feet wide, five feet long, and two and a half feet deep, containing eight inches of earth was the most satisfactory cage. A partition in the cage eight inches high and six inches from one end formed a bin in which was placed a feeding box filled with finely sifted earth. The purpose of the feeding box was to furnish a means of checking the amounts of eaten and rejected food in the ration and to prevent the earth in the main part of the box from becoming contaminated with decaying food. It was also found necessary to change the earth frequently before it became foul from excrement and to keep it moist by sprinkling. Some of the moles kept under these conditions lived for over a year, when the experiments were concluded, and death perhaps resulted from neglect. Although these animals require constant attention and much pampering, it is believed that they can be kept in captivity during their natural life.

## FOOD OF MOLES

As early as 1563, Gesner mentioned that the food of the European mole, *Talpa europæa* Linnæus, consisted chiefly of earthworms. Wilson ('98) examined the stomach contents of 36 moles (*Scalopus* and *Condylura*), and concluded that the animals were beneficial and that the

small amount of vegetable matter present was not eaten intentionally. He ascribed the damage done to vegetation as due to mice, Arvicolinæ, which take possession of unoccupied runways. From an examination of 34 stomachs of *Scalopus aquaticus machrinus* (Rafinesque) West ('10) found that earthworms constitute 31 per cent; adult insects, 23 per cent; insect larvæ 29 per cent; and vegetable matter 13 per cent of the food. He contended that the vegetable matter was eaten accidentally. Sixty-seven stomachs of *Scalopus aquaticus* caught during all months of the year, excepting February and December, were examined by Dyche ('03) and earthworms were found to compose one-half or more of the contents depending upon the weather and moisture content of the soil, while adult insects, insect larvæ, and a small amount of vegetable matter constituted the balance. He also concluded that the vegetable matter was eaten accidentally and that the damage done to plants was due to the process of digging, and to mice. Scheffer ('10) examined the stomach contents of 200 moles, *Scalopus aquaticus machrinoides* Jackson, collected in the vicinity of Manhattan, Kansas, and while plant materials were found in forty-three instances, he comments that "in no case was the amount of identifiable plant tissues more than might have been taken in incidental to the ingestion of other food." In a later publication Scheffer ('17) states: "The presence of starchy material in some of the stomachs is proof that the mole occasionally finds vegetable food, as certain seed grains softened by contact with the moist soil, an acceptable addition to its worm and insect diet. Seed coats of corn, wheat, oats and peanuts have been identified in a few stomachs." This survey seems to indicate that the majority of scientific opinions claim that moles are strictly carnivorous animals and very rarely, if ever, eat vegetable matter intentionally.

## FEEDING EXPERIMENTS

Six moles were weighed and placed in separate cages, which were provided with a close fitting screen cover to prevent the entrance of rats or mice. The articles of food making up the ration were weighed and placed in the feeding bins in the evening, and on the following morning the soil was sifted through a fine screen and the parts not eaten recovered, carefully weighed and recorded. By using soil of very fine texture in the feeding bins, it was possible to offer small seeds such as wheat and kaffir and to recover rejected parts by screening.

The ration included ground lean beef, earthworms, adult insects, insect larvæ, seeds, and vegetables. All seeds were soaked in water

before being fed. The soaking rendered their condition about the same as that of seeds planted in moist earth. The possible error due to the evaporating of water from the soaked seeds was prevented by drying the grain with a cloth before weighing, and by keeping moist earth in the feeding bins. Checks also showed that soaked grain placed in moist earth over night lost little or no weight. Large seeds like corn were usually counted in addition to being weighed. The heads of active insects such as grasshoppers and crickets were crushed to prevent their escape. It was not found necessary to decapitate the earthworms as they made no attempts to escape from the moist earth of the bin.

Each kind of food, when offered in the ration, was given in such quantity as to exceed the amount the mole could eat, even though an entire meal was made of the one article. This eliminated the error of forcing the animals to eat food as second choice due to the depletion of an item, which would be preferred if present. At times, and especially during dry weather, difficulty was experienced in furnishing the required amount of earthworms, but it was found that ground lean beef was eaten about as readily, and, for this reason, it was always offered in quantity. Careful study was also made of the possibility of food being carried from the feeding bins to other parts of the cage. Ritzema ('98) in his study of the European mole mentions finding 300 decapitated earthworms stored in a mole's nest, presumably for winter use, while food could not be obtained in the runways. Close observation failed to disclose any tendency on the part of *Scalopus aquaticus machrinoides* to carry food from one part of the cage to another, or to cache it. The feeding experiment was continued for a period of thirty-six consecutive days in all cases, excepting mole No. 3, which escaped on the twenty-eighth day. Each mole was examined periodically and notes made concerning its general health. That the animals were in excellent condition at all times during the experiment was shown by the fact that they gained in weight and maintained a uniform appetite.

The total amount of foods eaten during the experiment is shown in table 1. The different kinds of insects, seeds and vegetables in the ration were combined as a matter of convenience, and recorded separately. The insects used included grasshoppers, crickets, beetles, bees, wasps, butterflies, white grubs, and caterpillars. Of the seeds corn and wheat were used most extensively, while oats, peas, beans, and kaffir were introduced occasionally. Irish potatoes, sweet potatoes, tomatoes, carrots, radishes, turnips, raisins, and apples composed the vegetable part of the ration.

It is of special interest to note the selections made by the moles among the different articles of food in those classes of table 1, which include more than one item. Insect larvæ, and particularly white grubs, were eaten much more readily than the adult insects. Corn was the first choice of the seeds with wheat and oats occupying second and third places; beans, peas, and kaffir were invariably refused. Ripe tomatoes, apples, and Irish potatoes were the principal vegetables eaten; radishes, sweet potatoes, and carrots were very rarely eaten, and never in quantity; turnips and raisins were always refused.

In the presence of earthworms and insects, the mole's natural food, ripe tomatoes were by far the most common vegetable eaten. Out of the 162 grams of vegetable material eaten by mole No. 4 (table 1) 160 grams were of tomatoes. Of the 77 and 84.5 grams of vegetable

TABLE 1

*Quantities and kinds of food eaten*

| NO. OF MOLE | FRESH BEEF | EARTH-WORMS | INSECTS | SEEDS | VEGE-TABLES | TOTAL PER MOLE | DAYS |
|---|---|---|---|---|---|---|---|
| | *gr.* | *gr.* | *gr.* | *gr.* | *gr.* | *gr.* | |
| 1 | 185 | 312.5 | 194 | 154.5 | 77 | 923 | 36 |
| 2 | 321 | 139 | 157.5 | 67 | 33 | 897.5 | 36 |
| 3 | 200.5 | 208.5 | 122.5 | 101.5 | 84.5 | 717.5 | 28 |
| 4 | 373 | 274 | 146 | 151.5 | 162 | 1106.5 | 36 |
| 5 | 148 | 275.5 | 159 | 88.5 | 36.5 | 707.5 | 36 |
| 6 | 299.5 | 455 | 214.5 | 97 | 48.5 | 1114.5 | 36 |
| Totals .... | 1527.0 | 1844.5 | 993.5 | 660.0 | 441.5 | 5466.5 | 208 |

food eaten by moles Nos. 1 and 3 (table 1), 76 and 82.5 grams, respectively, were of tomatoes. Nos. 2, 5 and 6 ate 33, 36.5, 48.5 grams of vegetable food, respectively, of which 19, 33 and 44 grams were of tomatoes. Undoubtedly, tomatoes are very rarely, if ever, eaten as a part of the mole's natural diet.

Out of the 208 times that soaked corn was offered in the combination of foods shown in table 1, it was refused only 12 times. Wheat was offered 89 times and refused 60, and oats were refused 38 times out of 57 feedings. Oats and wheat were eaten only one-third of the time they were offered, and usually in small amounts. Only on two occasions did a mole eat more than four grams of either at one time. In contrast to this, the average amount of corn consumed during the 196 nights it was eaten was 2.96 grams. That moles actually relish corn is shown by the fact that they will eat some corn even when furnished with an

over-supply of their natural food. On one occasion a mole devoured 69.1 grams of white grubs and 2.5 grams of soaked corn in eighteen hours. Under the same condition another ate 43 grams of white grubs and 7 grams of corn during a single night. Many instances of this kind could be cited. An examination of table 2 will also show that 79.52 per cent of the food eaten by the six moles during the experiment was animal matter and that 20.15 per cent was vegetable matter. These percentages are about the same as those recorded by West ('10) for the stomach contents of thirty-four moles collected in the field. He found that the stomachs contained 83 per cent animal matter and 13 per cent vegetable matter. Thus it seems evident that approximately four-fifths of the natural food of a mole is animal matter.

TABLE 2

*Percentages of food eaten*

| MOLE | FRESH BEEF | EARTHWORMS | INSECTS | SEEDS | VEGETABLES |
|---|---|---|---|---|---|
| 1 | 19.98 | 33.75 | 20.95 | 16.63 | 8.31 |
| 2 | 35.63 | 35.40 | 17.48 | 7.43 | 3.36 |
| 3 | 27.86 | 28.98 | 17.02 | 14.10 | 11.74 |
| 4 | 33.67 | 24.74 | 13.18 | 13.68 | 14.62 |
| 5 | 20.01 | 39.12 | 22.57 | 12.56 | 5.18 |
| 6 | 26.86 | 40.81 | 19.19 | 8.70 | 4.35 |
| Average per cent.. | 27.33 | 33.80 | 18.39 | 12.18 | 7.97 |

That moles have the ability to adapt themselves to widely different foods was demonstrated by keeping them alive for long periods of time on rather unnatural diets. For example, two moles lived 44 days on a ration composed of ground beef, Irish potatoes, and apples. During the experiment, one gained 19 grams and the other 12 grams. Each ate liberal quantities of both apples and Irish potatoes. In another experiment, these same two moles were fed for 14 days on a ration of Irish potatoes and apples with ground beef offered every other day. At the end of two weeks, each had maintained its original weight, but had not made any appreciable gain.

## EXPERIMENTS ON FOOD PREFERENCE

During the experiment some of the moles grew very tame. One, in particular, would come to the surface of the soil and take food from a person's fingers. If one scratched in the earth of his cage, the snout

would usually appear as if for food. Many times when water was allowed to drip on the soil, the mole came to the surface and drank from the puddle like a pig. Advantage was taken of this tameness to make a further study of choice of food. The articles were offered the mole on a two tine fork constructed of stiff wire. When the mole's snout would appear at the surface of the soil, the tines of the fork bearing two different kinds of food would be placed so that the two foods would be equally distant from the tip of the snout.

When earthworms were checked against white grubs, the mole would usually take first one and then the other. The selection between these two foods varied from day to day. At times the mole chose earthworms more often than white grubs and, on other occasions, the reverse was true. The average, however, was a little in favor of the earthworm as first choice, but the difference was not great enough to show a pronounced preference between the two foods. When earthworms and white grubs were offered in combination with other foods, they were with very few exceptions taken as first choice. Insect larvæ, as a rule, were taken in preference to the adult. Adult insects were taken first when offered with corn. The latter was chosen in preference to vegetables. If the foods that were most commonly eaten are classified in accordance with the preference shown for them in these experiments, they will have the following order: earthworms and white grubs, insect larvæ other than white grubs, adult insects, corn and vegetables.

As the eyes of the mole are very degenerate and the objects were held too far away for the vibrissæ to be used, the decision was probably made for the most part, if not entirely, by smell. This opinion is also supported by the fact that the mole always made an immediate and definite decision by turning directly to the food of first choice. After devouring the first article, it usually returned for the food of second choice and, as before, went to it without hesitating. In fact, it very rarely made a preliminary examination before choosing.

An examination of tables 1 and 2 shows that a choice of food, in many ways comparable to that seen in the preference experiments, also took place when a ration composed of several kinds of food was presented. If the foods were listed in accordance with amounts eaten, they would also have the same sequence as that in which they would most likely be selected, namely, earthworms, insects, seeds, vegetables.

It is also of interest to note that when moles were fed a ration which included earthworms, insect larvæ, adult insects, corn, and vegetables,

each being present in amounts greater than could be eaten in twenty-four hours, they did not make a meal of the food that would most likely be selected as first choice, but would eat parts of several kinds. It is true that the amount of earthworms eaten was always greater than that of any other kind of food but the point at issue is the fact that they would usually eat some corn or even a portion of one or more vegetables as tomatoes or Irish potatoes.

In addition to the foods discussed in connection with the preceding experiments, the moles also ate certain other objects. English sparrow eggs, in all stages of incubation, were eaten with apparent relish. When an egg was given to a mole, he would crush it either by crowding it against the side of the burrow while trying to bite it, or by slapping it with the front feet. After breaking the shell he devoured the contents. Some of the moles became so dextrous that very little of the contents would be spilt. This egg eating propensity raised the question as to whether or not the mole was of any economic importance in robbing the nests of birds built on or near the ground. Grass nests five inches in diameter with sides and bottom one and a half inches in thickness, and sewed together with strong twine, were placed in the cages to see if the moles could gain access to eggs placed in them. It was found that a mole would dig a hole through the bottom of a nest of this kind, and take the eggs, even when the nest was supported in wheat stubble six inches above the soil in the box. The fact that the mole was in captivity must not be lost sight of, but these observations show what the animal is capable of doing. It would be very easy for moles to rob nests on or near the ground, if the animals were so inclined. Yet, if any incriminating data have been collected in the field to bear out this laboratory observation, the writer is unaware of it. The moles also ate young birds, spiders, wasps, and bees. One killed and devoured a skink while another captured and ate a frog. They have also been reported as having killed garter snakes and even small mammals.

### FOOD CONSUMPTION

The mole is noted for its ability to consume prodigious amounts of food. Scheffer ('17) states that "owing to their activity they sometimes consume each day a bulk of food equal to their own weight." The six captive moles under observation in this laboratory ate a total of 5466.5 grams of food (table 1) in 208 days, which is an individual average of 26.28 grams per day. The average weight of the six animals at the close of the experiment was 84.33 grams, which gives a daily

consumption of food equal to 32.08 per cent of the body weight. This perhaps more nearly represents the daily appetite of the animals, as hungry moles are known to perform greater gastronomic feats. A mole weighing 72 grams, which had not been fed for about 12 hours, ate 12 grams of lean beef, 10 grams of earthworms, 6 grams of grasshoppers, 4 grams of honey bees, 3 grams of corn, and 13 grams of ripe tomatoes in 18 hours. This amount is 66.6 per cent of the body weight of the animal. None of the several moles studied was able to eat a bulk of food equal to its own body weight in twenty-four hours.

The daily food consumption of an average mole may be strikingly compared with that of an average man. A man weighing 160 pounds would have to consume 51.32 pounds of food each day to equal, in proportion to his weight, the average daily consumption for the six moles used in this experiment. To equal the maximum capacity of a mole he would have to eat 106.5 pounds of food in eighteen hours. This comparison is all the more interesting from the fact that both animals are mammals.

When the amount of work that a mole is capable of doing in a single night is considered, one can readily see the necessity for such stupendous amounts of food. Lydekker ('01) mentions the formation of a burrow about 100 yards long during a single night. If a man weighing 160 pounds were to do a proportionate amount of work in the same time, he would have to dig a hole about 47.9 miles long and large enough in diameter to admit his body freely. The fossorial habit of the mole demands a great expenditure of physical effort in the pursuit of food. Ordinarily, the animal has to remove earth equal to several times its own body weight for each morsel.

## CAPTURING PREY AND FEEDING

A narrow box 2 feet long by 2 feet deep by 3 inches wide, and with glass sides, was used for studying the way in which a mole captures and devours its prey. This kind of a cage enabled the observer to watch the activities of the animal from the side. Moles that had been in the laboratory for some time and had become accustomed to being handled ate readily, and under these conditions it was possible to make detailed observations of every movement.

When a worm or an insect was introduced into the burrow, the mole usually discovered it by contact. This was perhaps due to the fact that the mole was usually busy at work and not hunting for food. A few times, however, when the mole was quiet and food was dropped

through a hole into the burrow, it seemed to be attracted either by sound or smell, or perhaps both. It is also true that the tactile sense is very highly specialized in the mole and it is possible that the vibrations produced by dropping food into the burrow were detected by means of the vibrissæ which, according to Ackert ('12) are richly supplied with sensory nerves. Then too, the exact importance of the gustatory, auditory and tactile senses have not been determined; and, until this is done, the question cannot be definitely answered.

The method a mole uses in attacking its prey depends entirely upon the resistance offered. If it encounters an active insect, a ground beetle for example, it immediately slams it against the side of the burrow with one of its big front paws and holds it, while at the same time it turns its head to examine the catch. If the prey is not crushed with the first blow, it is repeatedly mauled with the big paws and bitten or held against the side of the burrow while its body is being devoured piecemeal. The attack is vicious and executed with incredible quickness and agility.

The mole also captures active prey by piling loose earth on a victim, and devours it while holding it in this way. After an animal is buried alive the mole stands over the pile of earth and by means of the sensitive snout detects any effort of the prey to escape and immediately seizes with the teeth any part of the victim that may be projecting above the earth. This clever method not only handicaps captives by compelling them to scramble from beneath the loose soil, but it may also smother them.

During the process of eating, articles of food may or may not be held between the backs of the fore paws. Observations seem to indicate that moles more often eat an object that is resting on the bottom of the burrow then one that is held. While the animals are eating, the nose is constantly in motion, apparently in examination of the food and after the main part of the article is devoured, small bits, as insect appendages, etc., are eagerly sought for and eaten.

If the prey does not offer resistance, it is simply eaten. In the case of earthworms, however, it has been claimed that the mole pulls a worm through its claws while holding it between the backs of the paws and in this way frees the digestive tract of earth before devouring it. It is the opinion of the writer that this is incidental rather than purposeful. This is borne out by the fact that earthworms are not always held in this way. Observations show that earthworms may or may not be pulled through the claws and that the posterior end or middle

of the worm may be eaten first. When a mole eats an earthworm, posterior end first, it is very doubtful if any of the contents of the digestive tract can be forced out through the mouth even though it be pulled through the claws. The stomach of the mole may also contain much earth, probably ingested accidentally while feeding.

## THE ECONOMIC STATUS OF THE MOLE

When the mole is considered from an economic standpoint many of its activities can be cited as decidedly detrimental while much can be said in its defense as a beneficial animal. According to West ('10) about 50 per cent of the mole's natural diet consists of insects and insect larvæ, many of which are injurious. Under laboratory conditions, however, the mole showed a decided preference for earthworms (table 2) and, no doubt, this preference would also be demonstrated in nature, if insects were not usually more numerous than earthworms. The mole will also eat certain seeds, particularly corn that has been softened by the absorption of water. The animal should be commended for destroying injurious insects and condemned for devouring earthworms and seeds. The burrowing methods of moles make them a serious pest in gardens and lawns, and for this reason, if no other, they should be eliminated from these places. In non-cultivated fields moles probably do more good than harm by devouring quantities of immature and adult insects found in these places, but in cultivated fields they are decidedly harmful.

## SUMMARY

1. The mole is predominantly carnivorous in its food habits, but will eat certain seeds and vegetables even when supplied simultaneously with an over-abundance of insects and worms. 2. Corn is eaten very readily, while wheat and oats are eaten only occasionally. 3. Peas, beans and kaffir are not eaten. 4. Moles will eat ripe tomatoes, apples and Irish potatoes. 5. Sweet potatoes and carrots are very rarely eaten, while turnips and raisins are always refused. 6. Moles are capable of living and maintaining their body weight on a ration of fresh beef, Irish potatoes and apples even though the beef is offered only every other day. 7. Of the foods most commonly eaten, the following preferences are shown: 1, earthworms and white grubs; 2, insect larvæ other than white grubs; 3, adult insects; 4, corn; 5, ripe tomatoes; 6, Irish potatoes and apples. 8. The average daily food

consumption is 32.08 per cent of the body weight of the animal. 9. A mole is capable of eating 66.6 per cent of its body weight in eighteen hours. 10. The mole captures and kills active prey either by crushing it against the sides of the burrow with the front paws, or by piling loose earth on it and biting the victims held in this way. 11. The mole, perhaps, does more good than harm in uncultivated areas by destroying quantities of injurious insects, but in cultivated fields it is decidedly harmful.

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SKULL OF WOODCHUCK WITH MALFORMED INCISORS

(Wagner: Malformation in a Woodchuck.)

# AN ODD MALFORMATION IN A WOODCHUCK

By George Wagner

[*Plate 4*]

Overgrowth in the incisors of rodents, usually due to injury to the opposing teeth or to absence of opportunities for gnawing, is not uncommon, and specimens are occasionally picked up in the open. However, there was submitted to me recently a specimen so remarkable in this regard, that it seems worth while putting it on record.

The specimen consisted of the anterior portion of the skull of a woodchuck, and of the lower jaws practically intact. The incisors are complete and uninjured. The figures shown herewith illustrate quite well the nature of the malformation. Its immediate cause is also evident. The bone around the right upper incisor is badly diseased, so that the lateral half of the premaxillary is practically gone and the major portion of the alveolus of the tooth is laid open. The right nasal bone is also affected, its anterior portion being much corroded, and indeed perforated for a distance of about 5 mm. The right maxillary and frontal, and the left nasal show lesser signs of invasion by the disease. It is not unlikely, judging from appearances, that the primary injury was due to a glancing shot.

At all events it is evident that the injury markedly altered the direction of growth of the right upper incisor, crowding it to the left. The apex of this tooth now lies to the left of the midline of the skull. This change in turn has forced a change in the direction of growth of the left upper incisor, the tip of which now lies beyond the outline of the skull.

The lower jaw appears perfectly normal. But the position of the upper incisors has caused them to pass to the left of both lower incisors instead of opposing them. This in turn has forced the lower incisors to the right. As a result, with a closed mouth, these lower incisors must have come to bear on the upper lip of the right side. The effect could hardly have been a happy one.

The specimen was submitted to me for identification by Prof. W. E. Slagg, of the Eau Claire, Wisconsin, Normal School. It was found among the roots of a fallen tree, on the shore of Sand Lake, Chippewa County, Wisconsin. It is not easy to understand how the animal managed to keep alive during the long period it must have taken the teeth to reach the size they exhibit.

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## THE TUSSLE ON TIDE WATER CREEK

By William Everett Cram

Thirty years and more of observation have taught me that, in nature, as in everything else, it is often the unexpected that happens.

I have seen deer chasing a fox, and more than once a fox chasing a dog, and many another instance of the hunter hunted by his prey, yet I am never quite prepared to see the tables turned in this manner and when one morning I saw a muskrat chasing a mink I was completely surprised and taken aback. Now the mink is a wiry, slim bodied little hunter who lives almost entirely upon fish and meat, seems to prefer muskrat flesh to any other food, and hunts and kills muskrats, both old and young, at every season of the year.

A full grown muskrat is heavier than the average mink and is armed with long, chisel-like teeth, but is, by comparison with it, slow and inactive.

I was following up the winding course of a little tide water creek with the woods on one hand and the wide stretching salt marsh on the other. The slow tide was ebbing back to the sea. The August morning had been thick and hazy with the sea fog, but now the sun was burning the fog away and revealing the blue sky in fleeting glimpses overhead. At a point where the steep bank of the creek is overhung with the roots of oak and maple, a bunch of eel grass washed up by the tide had lodged against a half buried root.

I heard a rustle in this bunch of half dried eel grass and turned just in time to see a small mink dart down the steep bank and into the water, swimming away downstream as if in deadly fear; and close behind I saw a muskrat swimming in its wake. The mink took refuge in the coarse thatch grass on the bank, but the muskrat continued swimming down the middle of the current, turning its head from side to side with little beady eyes searching the grass-fringed banks. At a bend in the creek she turned and came slowly back, sculling against the tide. When within perhaps three rods of where I stood she apparently caught sight of the thing that she was looking for and turned with a swirl of her rudder like tail that brought her to within a few feet of the thatch, then gave a sudden upward spring clear of the water and, with three bounds through the tall grass, was up the bank. Then I heard the sounds of struggling and fighting and saw the coarse thatch grass waving in the still air. The conflict was on the same bank that I was and only a few yards away, but the thick grass prevented me from seeing

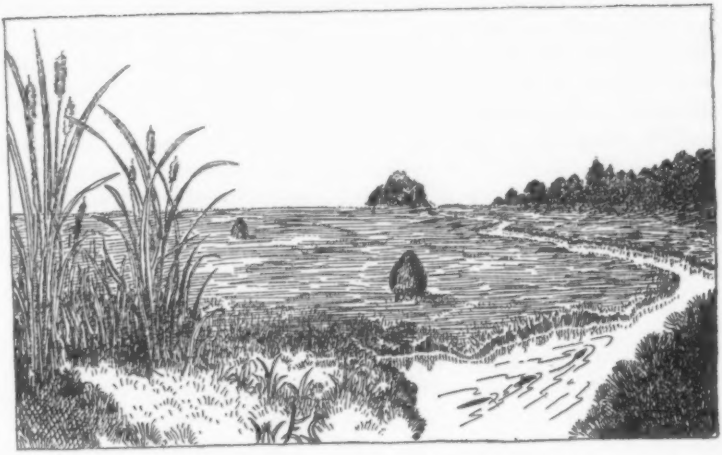

FIG. 1

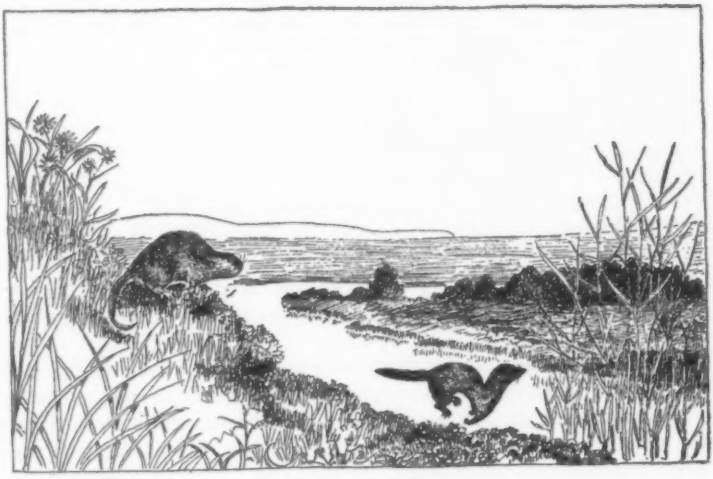

FIG. 2

the details of the struggle which lasted several minutes and filled the air with musk and that indescribable odor of an angry mink. Then the muskrat suddenly appeared, standing defiant on the short grass at the top of the bank, and the mink raced past almost under my feet, slipped into the stream, and disappeared.

With almost equal suddenness, out from beneath the overhanging roots at the top of the opposite bank, there popped two half grown muskrats followed by a third, much smaller—hardly bigger than a common barn rat—and all three came sliding, tumbling and summer-

FIG. 3

saulting down the slippery, wet clay and went splash, splash, splash under water.

Coming to the surface together, they hung there, with sniffing nostrils, sculling against the tide; then plunged downward to the entrance of their tunnel at the bottom of the creek just as a mink dashed down the slope after them. This performance I saw twice repeated; the three little muskrats sliding and tumbling down the bank, any way to get there quickest, splash, splash, splash into the water with the mink in hot pursuit. Then the big muskrat suddenly appeared amongst

them and away they all started upstream, swimming mostly under water, and, though I followed the margin of the creek as swiftly and noiselessly as I could, I saw only an occasional bobbing head and the ripple of the water in their wake.

Now all this took place with the usual suddenness and confusion of woodland episodes. I was unable to look both upstream and downstream at the same instant and undoubtedly missed seeing certain incidents that might have explained it all. I have told only what I saw and nothing that I guessed at, though naturally I was guessing all the time as well as observing. Anyone who is interested has the privilege of drawing his own conclusions. My own explanation of the affair is as follows:

Old Mrs. Mink started out this foggy August morning to give her family a lesson in hunting; discovering the muskrat family diving and paddling about in the creek she attacked them, followed by her offspring. Old Mrs. Muskrat may have been downstream clamming at the time, though her presence would hardly have deterred the minks from making an attack, as it is not in the nature of the mink to fear a muskrat—or anything else of equal size for that matter.

This particular muskrat, however, as I could well see, was an unusually large and dark colored specimen, undoubtedly an old and experienced mother who had reared and protected more than one family.

After overcoming and driving off the first mink, she had returned to find another pursuing her other little ones, and immediately put this new foe to flight, chasing him away upstream, with her own family following behind. As she stood in plain sight on the short grass after her tussle with the first mink, I could detect no sign of her having suffered any injury. Just how she managed to pounce upon and overcome so wiry and agile a fighter as the mink I am still somewhat puzzled to explain. The most satisfactory conclusion that I can arrive at is this. As I watched her swimming downstream, I heard—though I gave it little attention at the time—a snuffling, gurgling sound in the thatch, as if some little animal were greedily eating there. It may be that before I arrived on the scene, the mink had already succeeded in killing one of the young muskrats, and, hidden in the thatch, was gorging itself, when the old muskrat seized the opportunity to take her enemy by surprise.

When as a boy I began trapping muskrats and minks, I used to wonder why it was that while the female minks were always so much smaller and more slender than the males, the female muskrats were

generally—though not invariably—larger and heavier than their mates. Observation led me to the conclusion that the cannibalistic habit possessed by the old male minks, of devouring the very young of their own species, gave the advantage to those mother minks who were small enough to have their hidden nurseries among rocks and the roots of trees, with openings so narrow as to prevent the old males from obtaining access. The incident just recorded shows the advantage which greater size and strength gives to the mother muskrat in defending her young against the attacks of the mother mink and her young. Probably no muskrat would be strong or active enough to resist the attack of an old male mink, but these old male minks hunt alone, or in the company of other males; never—as far as my own observation goes—with the females and their families.

*Hampton Falls, New Hampshire.*

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## NOTE ON THE NEST AND YOUNG OF THE SMALL BROWN WEASEL

By Sherman C. Bishop

[*Plate 5*]

The burrow of a pair of small brown weasels (*Mustela cicognanii cicognanii* Bonaparte) was found May 14, 1921, by the side of a path which runs through a neglected field within the city limits of Albany, New York. The male was killed by boys and reached the State Museum in a mangled condition. The female, whose appearance indicated that she had been nursing young, was trapped the same day but escaped from the box in which she was later confined.

The galleries of the den extended in various directions and covered a considerable area but for the most part were within a foot of the surface of the ground. They were enlarged at intervals and held an accumulation of rubbish and remains of food. On the ground, by the side of the main entrance to the burrows, were the headless remains of two rats. The nest itself, in which were four young, was in a slightly enlarged chamber lined with rat fur, fine grass, and fragments of leaves.

The young, three males and one female, apparently only a few days old and blind, were put in a box with chloroform before being brought to my attention and only one, the female, was alive when discovered. This was photographed immediately.

MUSTELA CICOGNANII BONAPARTE. YOUNG FEMALE
Albany, New York, May 14, 1921; natural size

(Bishop: Nest of Brown Weasel.)

Notes concerning the habits and young of this weasel, that have come to my attention, make no mention of the peculiar mane-like development of the fur on the top of the head and neck (Plate 5, photo about natural size). Beginning at the line of the eyes, this brush extends back between the ears and tapers to a point between the shoulders. The fur is long, dense, and somewhat darker than that of the back. The tail is proportionally much shorter than in the adult, being only one seventh of the total length. In connection with the distribution of this species, it is of interest to note that the locality at which it was taken comes within the narrow belt of the Upper Austral area of the Hudson Valley. Dr. H. H. T. Jackson of the Biological Survey very kindly verified my identification of the adult male.

*State Museum, Albany, New York.*

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## TWO NEW AND RARE MAMMALS FROM COREA

By Nagamichi Kuroda and Tamezō Mori[1]

The following two mammals from Corea seem to us to be undiscribed.

### Petaurista leucogenys thomasi subsp. nov.

*Diagnosis.*—Resembles *Petaurista leucogenys leucogenys* (Temm.) from South Kiusiu, Japan, but the tail decidedly shorter (235 mm. instead of 387 mm.); the hind foot also shorter (59 mm. instead of 65 mm.); the fur of back much more tinged with rufous-brown instead of more buffy tips to the hairs of back in *leucogenys;* the tail rather paler than the back instead of darker brown tail in the typical form; the underparts much whiter tinged with pale vinous in the center and becoming wine-rufous in the marginal membrane.

*Measurements.*—Head and body, 475 ± mm.; tail, 235 mm.; hind foot, 59 mm. (measured on the skin). Skull not examined.

The type specimen was purchased at Seoul game-market, C. Corea, February, 1920, and is preserved in the First Higher Common School in Seoul.

Named in honor of Mr. Oldfield Thomas of the British Museum.

### Martes melampus coreensis subsp. nov.

*Diagnosis.*—Near to winter pelage of *Martes melampus melampus* (Temm.) of Kiusiu and Hondo, Japan, but the general color of upper parts yellow washed with fox-red instead of rich orange-yellow, and the ashy-white of head extending farther to the nape instead of confined to forehead. It differs from *M. melampus*

[1] Teacher of the First Higher Common School in Seoul, Corea.

*bedfordi* (Thomas) of Hondo, by the upper parts very much paler instead of brownish-yellow, by the muzzle region nearly white instead of dark brown, by the orbital ring and lores only faintly tinged with dark brown, by the interramia and lips being whitish instead of dark brown, and by the throat and hairs of the tip of tail much paler and whitish, the latter somewhat tinged with grayish-yellow. It differs from *M. melampus tsuensis* (Thomas) from Tsushima between Kiusiu and Corea, by the much paler coloration of body and by the muzzle, lips and limbs being very much paler.

*Measurements (measured on the skins).*—

| | *Head and body* | *Tail* |
|---|---|---|
| Type | 545 ± mm. | 238 ± mm. |
| | 470 ± " | 190 ± " |

Skulls not examined.

The type specimen was obtained at Tenan, S. Chūsei District, Corea, December 17, 1920, and is preserved in N. Kuroda's collection.

Another specimen, probably rather younger than the type specimen, obtained at Seikan, S. Chūsei District, Corea, December, 1921, has the upper parts yellow faintly washed with brownish; the interramia and lips grayish-brown; the throat and hairs of the tip of tail end much paler than the back and clear orange-yellow; and the ashy-white head confined to the forehead and darker than in that of the type specimen. The supposed younger specimen is preserved in the First Higher Common School in Seoul.

This form is rather nearer to *melampus* than to *bedfordi* in the coloration of winter pelage. Summer pelage of the new form not examined. *Charronia flavigula* subsp. is a more common animal in Corea than this form, which seems to be very rare in the peninsula.

*Fukuyoshi Cho, Akasaka, Tokyo, Japan.*

# NOTES ON THE HABITS OF THE CHIPMUNK, TAMIAS STRIATUS LYSTERI

By A. Brooker Klugh

[*Plate 6*]

Since it is highly desirable to place on record all accurate data concerning the habits and life-histories of our wild mammals I wish to bring together here some observations on the habits of the chipmunk, *Tamias striatus lysteri*, which I have made at various times and places.

In the spring of 1904 at my summer cottage at Puslinch Lake, near Guelph, Ontario, a chipmunk used to come on the verandah to be fed. I gave it various things to eat and its favourite was crisply-cooked bacon rind—an article of diet which has been refused by all the chipmunks I have fed since. One day I heard a commotion in the apple-tree which stood just in front of the door and looking out I saw a couple of blurred streaks going up the trunk, out on a limb, down to the ground, up the trunk again, and so on, in a circle. When the pace of the animals slackened somewhat I made out that the first streak was a chipmunk and the second streak was a weasel, *Mustela cicognanii*. Reaching for my gun, I waited until the chipmunk had jumped from the end of the limb, and aiming where the weasel ought to be the next second, fired and killed it. The chipmunk lay exhausted and panting and I picked it up and placed it on the verandah, where after a time it recovered. It was quite easy to see, from the exhausted state of the chipmunk, what would have been the normal end of the chase. I knew previously that the chipmunk could climb trees with ease and agility, but I have never seen such an exhibition of climbing at high speed as I witnessed on this occasion.

On May 29, 1916, in the maple-beech forest of the Bruce Peninsula, Ontario, I saw chipmunks digging something up from beneath the dead leaves and eating it, and upon investigation found that they were feeding on sprouting beechnuts.

While in camp at Lake Missanag, Ontario, in August and September, 1919, a chipmunk with a very short tail, and an unusually deep coloration, had its abode in the vicinity of the tent. The home range of this individual was 100 yards by 75 yards in extent, and she was never seen out of this area. She was feeding on three things which I had not previously seen this species eating—the fruits of the bunchberry (*Cornus canadensis*), the fruits of the wild lily-of-the-valley (*Maian-*

*themum canadense*), and the seeds of the star-flower (*Trientalis americana*). As far as I could ascertain she was not storing any of these.

I offered her various foods and she refused meat and sweet substances, but accepted seeds, fruits and tubers. By far her favourite item was corn—either raw or boiled. Of this she sometimes ate a kernel or two but carried most of it away in her cheek-pouches. In loading up her pouches she placed the kernels alternately first in one pouch then in the other, and when they were nearly full she shoved the last few kernels in with one of her forepaws. A full load, as tested several times, consisted of thirty-one large kernels—equal to two heaped-up tablespoonfuls. I saw her drink once, and upon this occasion I could not commend her choice, unless "internal bathing" was the result sought, as she lapped up some soapy water from the hand-basin.

With this individual I made some tests to learn something of her psychology, and secured some data upon one phase—the rapidity with which she formed associations. After I had placed kernels of corn for her in a certain spot a few times I began to throw kernels to her. At the first trial the sudden motion of my arm naturally frightened her, as any sudden motion will do with any wild animal. At the second trial she started but slightly and came and picked up the kernels, and at the third trial she showed no alarm at the motion, but ran towards me and picked up each kernel as it fell. I next threw her half-a-dozen kernels, each one nearer to me than the last, and then held out the cob near the ground, when she came up and bit the corn from the cob. After this she associated the holding out of anything with the procuring of food and came at once. I next tried out her power of association of sounds. I held out a cob of corn and made a squeaking noise with my lips, and after five trials, two on one day and three on the subsequent day, she came running up on hearing this sound, even though I held nothing extended towards her. That associations remained for some length of time was shown by an incident which was not planned as an experiment. My Indian friend, Sowatis Lachance, had given me a cob of the peculiar hybrid corn which he grows, in which the kernels are of various colours, and I had placed this on the top shelf of a set of shelves in the tent. Early the next morning the chipmunk came into the tent, climbed up to the shelf, and stripped the cob. For five days subsequently she continued to investigate that shelf, visiting it regularly every morning, and several times during the day, though no more corn was placed there, nor anything else edible.

After this chipmunk had learned to take corn from the cob held in my hand she would come after it no matter where I held the cob, running up my leg and sitting on my knee or shoulder while filling up her pouches, and would sit on the cob and strip off the kernels even when I lifted the cob up in the air.

In August and September, 1920, we camped in the same spot, but the chipmunk of which I have given an account above had disappeared. Seeing a chipmunk about a hemlock stump at the edge of the woods near the tent I placed kernels of corn and raisins on top of the stump, and three chipmunks came to carry off the food, thus giving me an opportunity to make a few observations on the social life of this species. Two of these chipmunks were very similar in size and coloration, the only difference being that the stripes on the side of the head of one were slightly more distinct than those of the other; but the third was easily distinguishable by its duller coloration, larger size, and the obscureness of the stripes on the side of the head. I shall call them Nos 1, 2, and 3, in the order mentioned above.

No. 1 and No. 2 were very friendly and on one occasion I saw them rub noses. No 3 was not amiably disposed towards the others and if either of them were on the stump when it arrived it chased it away. Sometimes pursuer and pursued would go round and round the stump with great rapidity, exhibiting marvellous agility in racing about on its smooth sides. In their general manner Nos. 1 and 2 were much alike, and neither of them paid much attention to me, even when quite close at hand, once they had overcome their first shyness, but No. 3 was always "jumpy," and was not noticeably tamer at the end of the period of observation than at the beginning. No. 1 was the most confiding of the three, and on the third day allowed me to approach within a foot of it, while on the ninth day it took food from my hand.

Yellow-jackets (*Vespula diabolica*) were extremely abundant, and many came to feed on the raisins and boiled corn on the stump. One day No. 2 was stung on the front paw and shook it violently, then licked it.

These chipmunks were gathering hazel-nuts (*Corylus rostrata*), climbing the shrubs, cutting off the nuts and carrying them away. They did not waste any time cutting off bad nuts, as all the nuts left on the bushes after the chipmunks had visited them proved on examination to be bad.

In the immediate vicinity of the Biological Station, St. Andrews, New Brunswick, in the summer of 1921 there were three chipmunks.

One, subsequently called "Nipper," was the largest and grayest, "Fuzzy-tail" was distinguished by a somewhat scant-haired tail on which the hairs usually stood out almost at right angles and by a brighter coloration, and "Erythro" was so named on account of its very reddish coloration. They were feeding on the fruits of the raspberry (*Rubus ideas aculeatissimus*) and those of the red-berried elder (*Sambucus racemosa*), climbing the bushes to obtain them.

We began to give them peanuts, and at once the marked difference in their dispositions became apparent. Nipper was by far the boldest, and in a few days was taking food from our hands and climbing all over us. He seemed to have some difficulty in distinguishing between a peanut and the tip of one's finger, and the severe nips he administered because of this delusion earned him his name. If I held my hand 18 inches from the ground he would jump up onto it, and would jump up on my hand and take peanuts from between my teeth. Of the various chipmunks I have tamed Nipper was the only one which allowed himself to be stroked, as all the others have regarded the hand coming down to stroke them with suspicion and have jumped the second it touched them. Fuzzy-tail soon became tame and ran all over us, but was much more easily frightened than Nipper, and was also far gentler. Erythro, though it would sometimes come and feed from the hand, was always "jumpy" and very uncertain, being comparatively tame one day and quite timid the next. The behavior of these chipmunks among themselves showed correlation with their relative boldness with us, as Nipper would chase Fuzzy-tail, and both chased Erythro. One day Nipper and Fuzzy-tail sat looking at one another like a couple of cats about to fight, then Nipper jumped clean over Fuzzy-tail and alighted facing her, and the latter ran.

Erythro gave me the only example of defective instinct which I have come across in my studies of chipmunks and red squirrels. At the place where we fed these chipmunks there was a patch of gravel from the beach, and we often put peanuts down on this. Nipper and Fuzzy-tail picked out the peanuts, by sight checked by smell as far as I could judge, with certainty, but Erythro would pick up a peanut, then a small round pebble, another peanut, more round pebbles, and load them all into its pouches. Instead of improving as time went on its discrimination grew worse, till it would come and fill its pouches with nothing but stones, taking even rather large flattened stones which it could hardly cram into its mouth, and go off with its pouches hanging down from the weight of the stones which rattled at every bound.

*Queen's University, Kingston, Canada.*

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3

4

5

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CHIPMUNK (TAMIAS STRIATUS LYSTERI)

FIG. 1.—Nipper about to jump. 2.—The result of the jump. 3.—Nipper smells over the log for nuts. 4.—Nipper fights for a nut and the exertion spreads the hairs of his tail. 5.—Nipper takes a nut from the author's mouth. 6.—Fuzzy-tail.

(Klugh: Habits of the Chipmunk.)

# DESCRIPTION OF A NEW MICROTINE RODENT FROM OREGON, WITH REMARKS ON SOME CONTIGUOUS FORMS

By A. Brazier Howell

In identifying some meadow mice recently acquired, I found it advisable to make a careful study of certain forms occurring in the northwestern coast section. As the races herein considered have no distinctive patterns of dentition that are at all constant and dependable, and have suffered quite a little confusion, it may be of general interest to present the somewhat fragmentary results of my study.

*Microtus macrurus* occurs at many points throughout the Sitkan district of Alaska, and it there breaks up into a number of local variants which are puzzling. Heretofore, this race has not been recorded south of the Olympic Peninsula in Washington, but specimens, herein described as a new subspecies, have recently been obtained upon the coast of Oregon, where it has been confused with *Microtus townsendii*, the latter in turn having been confused with *Microtus mordax angusticeps*.

## Microtus townsendii (Bachman)

*Comparative characters.*—Specimens from Oregon City and Tillamook County, Oregon, assumed to be typical, compared with typical *macrurus*, are larger, browner and darker, tails much shorter, feet more robust and slightly longer. The skull is more heavily ridged, with much larger bullæ, and the incisive foramina are longer, narrower, and constricted posteriorly. This pattern of incisive foramina readily distinguishes *townsendii* from all races of the *mordax* and *californicus* groups. The bullæ of *angusticeps* are very much smaller, and its small size and the quality of its pelage at once differentiate that race from *townsendii*.

*Range.*—This species occurs in favorable situations throughout the Puget Sound region, thence south along the coast as far as Eureka, California. It ranges for an indeterminate distance up the Willamette River valley of Oregon, and probably up the Rogue River as well, as it has been taken at Prospect, Jackson County.

*Remarks.*—The present species has heretofore been included in the subgenus *Microtus*, the members of which, besides possessing a number of distinctive characters, have six tubercles upon the sole of the pes. The only alcoholic *townsendii* which I own has but five tubercles, without the vestige of a sixth, and this seems also to be the case with several of my skins, the hind feet of which I relaxed; but dried feet with wire inserted relax in an unsatisfactory manner, and I cannot be absolutely certain in regard to them. Suspecting that the closely allied *Microtus tetramerus* might exhibit the same character, Dr. J. Grinnell kindly examined the five spirit specimens of this species in the Museum of Vertebrate Zoölogy, and reports that some have five tubercles with faint indication

of a sixth, and others, six distinct tubercles. This should mean either that *townsendii* must be removed from the subgenus *Microtus*, or else that the number of tubercles of the pes in that subgenus must be stated as variable. However, I suspect that the number of tubercles has merely been inferred in the cases of many species of voles, and I wish to propose no change until I have had the opportunity to study alcoholic specimens of a large number of species.

Individuals from Tacoma and Potlatch, Washington, have bullæ that are very slightly larger than typical, but they are otherwise indistinguishable. Elliot (Field Columb. Mus., Zoöl. Ser. 3, 1903, p. 189) records twenty specimens of *townsendii* secured by E. Heller at Eureka, Humboldt County, California, and quotes the field notes of the collector to the effect that the animals were "common about tidewater, with habits very similar to those of a muskrat." These specimens seem never to have been seriously considered until recently, and the species was not admitted to the California list by Grinnell. Kellogg (Univ. Calif. Publ. Zoöl., 21, 1922, p. 295) states that "in the vicinity of Eureka . . . . , individuals of large size have been collected which are unquestionably referable to the *mordax* group," and lists them under *angusticeps*, but he writes me that he was unable to examine them at the time he was working with the meadow mice of the state. I was enabled to study this series through the kindness of Dr. W. H. Osgood of the Field Museum, and a careful examination shows that this supposed identification is erroneous, for they are entirely distinct from *angusticeps*, and perfectly good *townsendii*. In corroboration of this view, the feet of two of these skins which I relaxed seem to have but five tubercles. The Eureka examples differ from typical in having the interparietal more strap-shaped, incisors heavier and longer, palatal pits deeper, and bullæ smaller. In addition, the tail is somewhat more strongly bicolor, and this member is 33 per cent of the total length, as contrasted with 30 per cent in Oregon specimens. However, the two suites of animals were secured by different collectors, and a comparison of measurements should therefore not be taken too seriously. On the whole, the differences are slight, and do not merit subspecific designation. Specimens from Prospect, Jackson County, Oregon, differ slightly from typical, as mentioned previously (Journ. Mamm., I, 1920, p. 141).

*Microtus townsendii* is essentially a vole of the marshes and meadow bottoms, but it is by no means restricted to such situations, and I have taken it in the brush on the coast of Oregon far from fields or boggy land. It may extend with but few interruptions in distribution as far as Eureka, but it seems more likely that the Humboldt Bay animals are somewhat segregated. It is odd that Heller secured a good series in the latter locality while no one else has taken the species there. However, as his published notes imply, the specimens were evidently trapped well out on the salt marshes, where most collectors in the region would not be so likely to go.

### Microtus mordax macrurus Merriam

*Comparative characters.*—Compared with *Microtus mordax mordax* from the Cascade Mountains of Oregon, six specimens from the Olympic region of Washington, for an examination of four of which I am indebted to Dr. E. W. Nelson of the Bureau of Biological Survey, differ in the following particulars. The coloration

is less gray, especially on the head, and the feet are brownish instead of grayish. The underparts are usually (though not always) browner and darker, and the tail, as well as the feet, longer. The braincase is somewhat less ridged and angular, and wider in the interparietal region. The nasals and the interpterygoid fossa are slightly wider, and the incisive foramina are narrower and situated farther from the alveoli. The interorbital constriction has been said to be less, but I do not find it so.

*Distribution.*—From Yakutat, Alaska, south through the Olympic Mountains of Washington, and on Mount Rainier. Possibly also coastwise as far as the Columbia River.

*Remarks.*—There are slight grounds for considering *macrurus* a full species, and many reasons for placing it as a subspecies of *mordax*. The relationship between the two is close—more so than between true *mordax* and *angusticeps*—and a study of the animals in question shows that this is the logical course to pursue. The area of intergradation between these forms is not definitely known, but probably exists, or has recently existed. Two specimens from Mount Rainier loaned me by the Biological Survey are labelled *macrurus*. Although the skulls to these skins show slight departures from both that form and *mordax*, they vary considerably towards the latter. On the whole, however, they are nearer *macrurus*, and in coloration and length of tail are indistinguishable from Olympic Mountain skins. This may mean either that the area of distribution of *macrurus* was at one time continuous across the Puget Sound lowlands, or that the *mordax* stock occurring on Mount Rainier has encountered conditions approximating those of the Olympic Mountains so closely that somewhat similar variational results were attained.

Specimens of *macrurus* from southern Alaska are puzzling. Series from almost every locality available show slight, consistent differences, but in no case are these sufficient for subspecific rank, and they must all be included under the one name. Skins from Anan Creek, Sundum, and Glacier Bay are considerably darker than typical, but others from Clearwater Creek on the Stikine River, Wrangell, and Prince of Wales Island are of about the same color as those from Washington. Many of my northern skins are without measurements, but the tails seem to be shorter, and, in the Glacier Bay animals, more sharply bicolor than usual. The feet average much paler—almost white—but there is some variation in this respect. On the whole, the braincases of the Alaskan specimens are somewhat broader and flatter, the rostra and nasals slightly shorter, while the bullæ and pterygoid regions are variable.

In my collection are seven skins of *Microtus* taken upon Coronation Island, Alaska, by E. P. Walker in 1917. These were all that he obtained, and although they have pterygoid plates that are rather heavier, they are no larger than typical *macrurus*, and are clearly referable to that form; this is also the opinion of H. S. Swarth. At the time of Mr. Swarth's visit to this island in 1909, he secured 22 voles which he subsequently described as *Microtus coronarius*. This was characterized as similar to *macrurus* but very much larger. That being the case, it is hardly likely that both forms could exist on the one small island. It is possible, though I do not say probable, either that at the time of Mr. Swarth's visit such favorable conditions obtained that the vole population was stimulated to extraordinary growth, or else that during Mr. Walker's visit, the reverse was the case

and the usually large *coronarius* had become stunted. This theory would be untenable in the case of most genera, but veritable giants of some species of meadow mice are occasionally taken. However, a third collection must be secured from Coronation Island before the matter can be advantageously discussed.

### Microtus mordax abditus subsp. nov.

*Type.*—Male adult, skin and skull; no. 2731, coll. of A. B. Howell; Walker's Ranch, Pleasant Valley, 8 miles south of Tillamook, Oregon; September 8, 1920; collected by A. B. Howell.

*Range.*—Ten specimens are available from the type locality, Blaine, and Netarts, Tillamook County. The range probably extends along the humid coast strip from the mouth of the Columbia River to southern Oregon, or possibly into extreme northern California.

*Diagnosis.*—Closest to *macrurus* but darker, with longer tail and feet. Skull longer and more rounded in all parts, presenting a weak appearance. Supraorbital ridges almost absent, and supraorbital border more sloping, with postorbital processes poorly developed. Bullæ larger, their postero-inferior portions being farther apart, and the zygomatic arches are less flaring. The incisive foramina are slightly shorter, palatal pits shallower, and molariform teeth somewhat lighter.

*Measurements.*—The measurements of the type in the flesh are: length, 221 mm.; tail, 93; foot, 28.5. In nine specimens, the tail averages 41 per cent of the total length.

*Remarks.*—*Microtus "macrurus"* evidently has never been recorded from Oregon, but at the time of my visit to that state in 1920, A. Walker had one long-tailed vole, and there are undoubtedly a few others in collections. I found the animals rather difficult to trap, and although two were secured in a small ditch filled with cat-tails beside a road, they evidently meet with too much competition from the commoner *townsendii* in such situations; the remainder were taken in salal thickets bordering a small, non-marshy brook near the sea.

This is a well-marked race, but is clearly the Oregon representative of *macrurus*. The Columbia River may be the dividing line between the two forms, or *macrurus* may be found to extend no farther south along the coast than the Olympic Peninsula, as heretofore believed.

### Microtus mordax angusticeps Bailey

In my collection is a vole from Crescent City, Del Norte County, California, which is considerably larger (length, 200 mm.) than normal *angusticeps*. Kellogg (*loc. cit.*, p. 295) identifies this specimen as an intergrade between that form and *Microtus mordax sierræ*, but there are no grounds yet for presuming that either *sierræ* or true *mordax* descends to the lowlands along the coast anywhere within their ranges. Intergradation between *angusticeps* and *abditus* might possibly occur, for it is not improbable that the ranges of these two will be found to overlap. J. Grinnell is of the opinion that the above specimen is merely an extraordinarily large *angusticeps*, and after further studying the matter, I fully concur

in his opinion. The skull is thoroughly typical of that form except in such accentuation of characters and pronounced angularity as is usually found in very large voles. Its color, and several cranial characters, chief among which are its very small bullæ, definitely preclude the possibility of its nearer affinity with any other race of *mordax*.

This subspecies is a very aberrant member of the *mordax* group. It was evidently segregated from the parent stock at an early date, and except for the fact that its desgination as a subspecies seems more convenient in expressing its relationship, it might with equal propriety be accorded full specific rank.

*Pasadena, California.*

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## SOME NOTES CONCERNING THE BREEDING HABITS OF THOMOMYS TOWNSENDI, OBSERVED NEAR VALE, MALHEUR COUNTY, OREGON, DURING THE SPRING OF 1921

By Everett E. Horn

[*Plate 7*]

In order to ascertain the certainty of the method of checking the results obtained in poisoning pocket gophers, the assumption being that only one individual inhabited a runway or system of runways, it appeared feasible to conduct a trapping program for a short time. For this work the "No. 44," or California, box trap was used.

Very early it was apparent that breeding was in progress and many female specimens were taken that were suckling young, as shown by the dampened, twisted condition of the fur surrounding the teats, and the presence of milk in the mammary glands. Trapping was started on March 27, 1921, and continued over a period of three weeks. Following is a brief statement concerning the specimens taken, together with illustrations to assist in demonstrating that this species has two or more litters a year.

On March 27, one adult female of moderate size, observed very soon after being taken (on Doctor Fortner's ranch, half a mile from Ontario, Oregon), showed definite signs of lactation, the mammæ being greatly enlarged and containing an abundance of milk, and the hair about the teats being moist from recent suckling. The opening in the runway back of this specimen was tightly plugged, indicating the presence of another inhabitant.

The trap was reset and 20 minutes later an immature male, 180 mm. in length, was caught. During the next two hours, three more young males of identical size were taken from the same hole. The following morning an immature female was found in the trap, evidently the last of the family, for the hole remained open for three weeks. Fig. 1 shows the female with three of these young. Examination of the specimen disclosed six well-developed fetuses. Fig. 2 shows the same female with the abdominal viscera dislodged so that the six fetuses are plainly visible.

Further records were obtained on the K. A. Herret ranch, 3 miles south of Vale, Oregon, results of examination of which are shown in the following table:

| SPECIMEN NUMBER[1] | DATE CAUGHT | CONDITION OF UTERUS | NUMBER AND DEVELOPMENT OF FETUSES |
|---|---|---|---|
| 1* | March 29 | Congested, evidently pregnant | |
| 2 | March 29 | Pregnant | Ten, small |
| 3* | March 29 | Pregnant | Three, large and well developed |
| 4 | March 29 | Pregnant | Eight, small |
| 5 | March 29 | Normal | |
| 6* | March 29 | Congested | Indistinct |
| 7 | March 29 | Pregnant | Eight, well developed |
| 8* | March 29 | Pregnant | Seven, very small |
| 9 | March 29 | Large, evidently pregnant | |
| 10* | March 27 | Pregnant | Six, well developed |
| 11 | March 29 | Pregnant | Seven, very small |
| 12* | March 29 | Pregnant | Not clearly visible |
| 13* | April 1 | Congested | |
| 14 | April 1 | Pregnant | Seven, half developed |
| 15 | April 1 | Slightly enlarged | |
| 16 | March 31 | Pregnant | Six, well developed |
| 17 | March 31 | Pregnant | Six, well developed |
| 18 | March 31 | Pregnant | Seven, well developed |
| 19* | March 31 | Pregnant | Seven, well developed |
| 20* | March 30 | Normal | |

[1] Specimens referred to are embryonic and are preserved in formalin at Portland, Oregon. Those followed by an asterisk (*) showed evidence of suckling young.

It will be noted that 9 of the 20 females examined showed evidence of suckling young. Of these, four (Nos. 3, 8, 10, and 19) were pregnant, with well-developed fetuses; and four others (Nos. 1, 6, 12, and 13) showed signs of pregnancy. Except in one case (No. 3) it is not reason-

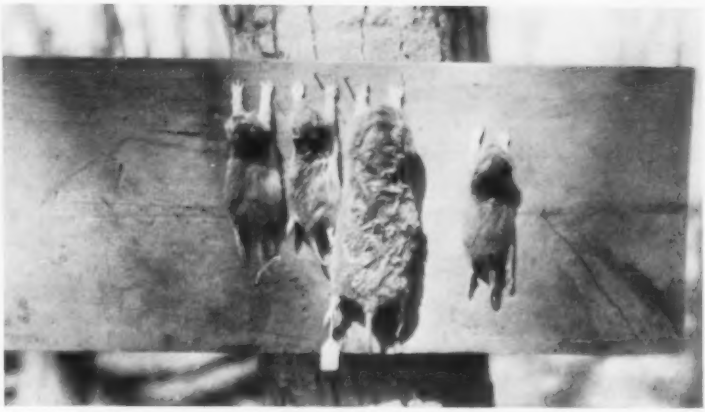

FIG. 1.—Adult female taken March 27, 1921, near Ontario, Oregon, and three of the five young taken from same hole.

FIG. 2.—Same female with abdominal viscera dislodged showing six young in uterus.

THOMOMYS TOWNSENDI

able to assume that development was sufficiently advanced to account for lactation, and the natural inference is that the female was caring for an earlier litter.

From trapping conducted it was found that more than one pocket gopher inhabited a single runway, both males and females and varying numbers of each being caught from many holes. This material is of no little value as it demonstrates the futility of trying to conduct bait efficiency tests during the spring of the year, when the killing efficiency of the bait is determined by whether the hole is left open or closed. Under the conditions as described, should one or more pocket gophers be killed there may still be others left to close the opening made into the run, thus seeming to indicate that no kill has been made, and in this way leading to wrong conclusions. However, the data set forth in the fore part demonstrate clearly that *Thomomys townsendi*, in the Snake River valley of Malheur County, Oregon, has at least two litters a year, and that these are born in close succession.

*Biological Survey, U. S. Dept. of Agriculture.*

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## LIFE ZONES AND MAMMALIAN DISTRIBUTION

By L. R. Dice

The recent appearance of a paper[1] on the life zones and mammals of Alabama has prompted a critical study of the zones mapped for the state in an attempt to determine the value of life zones for the statement, classification, and perhaps explanation of mammalian distribution.

For the section of the publication containing the annotated list of mammals I have only praise. Exact locality records are given, and excellent original notes are included on habits as well as on habitat preferences and other factors which are probably of importance in the limitation of distribution.

Two life zones are recognized in Alabama, the Upper Austral zone, "in rather dilute form," covering small areas on the highlands of the northeastern part of the state; and the Lower Austral zone covering the remainder of the state.

Six physiographic divisions are recognized in the state, brief descriptions of physiography and vegetation being given for each. However,

[1] Howell, A. H., U. S. Dept. Agric., N. Amer. Fauna, no. 45. 1921.

the Gulf Strip is the only one of these divisions of which the distribution is mapped, or of which the characteristic mammals are listed. The Gulf Strip is considered a part of the Lower Austral zone. The other physiographic divisions are evidently of less faunal significance, although the southern limit of the Mountain Region would probably coincide closely with the southern limits of distribution of several forms, notably *Sylvilagus transitionalis* and *Marmota monax monax*. Somewhere near the borders of the Prairie Belt or the Coast Pine Belt *Peromyscus leucopus leucopus* reaches its southern limit, and the meeting place of the two races of *Peromyscus gossypinus* is near the same line.

Sixty-five species and subspecies of mammals are listed as occurring in Alabama. Twenty-two species (23 subspecies) are apparently generally distributed in the state; and seven forms are so imperfectly known in the state that they cannot be used in a critical analysis of distribution.[2] Nineteen species (22 subspecies) are listed as characteristic of particular life zones, or parts of life zones. The remaining 13 subspecies are evidently assumed not to be restricted to particular life zones.

In the list given of the characteristic species of the Upper Austral zone in Alabama only three mammals are mentioned. Of these, *Mustela noveboracensis* is known in the state by only one specimen, so that it is not known whether it occurs in all the areas of the state mapped as Upper Austral. *Neotoma pennsylvanica* ranges over a considerable part of the state mapped as Lower Austral, its southern limit in the state being the Tennessee River. *Marmota monax monax* is stated by Howell to occur also in the mountainous parts of the Lower Austral zone. None of these forms then are certainly diagnostic of the Upper Austral zone as mapped for the state.

Eighteen species of mammals are listed as characteristic in Alabama of the Lower Austral zone, seven of these species being confined to the Gulf Strip. Of those species listed as ranging nearly throughout the Lower Austral zone and being limited northward by it, *Nycticeius humeralis* and *Oryzomys palustris palustris* are stated by Howell to occur locally also in the Upper Austral zone; *Peromyscus polionotus polionotus* and *Geomys tuza mobilensis* each occupy only about half the area of Lower Austral in the state; *Sylvilagus aquaticus* does not occur in the eastern part of the Gulf Strip; and *Neotoma floridana floridana* is limited in distribution northward by the Tennessee River, so that a

[2] My tabulation.

considerable area of Lower Austral north of the river is not occupied by it. It should be noted that *Peromyscus gossypinus* is represented in the state by a northern and a southern subspecies, which meet about the middle of the state. Specimens of *Mustela peninsulae olivacea* are available from only four localities in Alabama, although weasels are known to occur in many parts of the state; however, the exact ranges of the two species found in the state are not known. *Sylvilagus aquaticus*, in addition to not occupying the whole area of Lower Austral in Alabama and in being represented in this zone by two subspecies, also occurs at Fayetteville, Arkansas[3] in an area mapped as Upper Austral.[4] *Blarina brevicauda carolinensis* almost certainly occurs also in the Upper Austral zone in states to the north.[5] *Peromyscus nuttalli aureolus*, *Peromyscus gossypinus* subspp., and *Sigmodon hispidus hispidus* may be accepted as limited closely to the Lower Austral zone and to extend throughout the zone in Alabama.

Of the seven forms listed as confined to the Gulf Strip, *Nycteris seminola* occurs sporadically nearly to the northern boundary of the state and *Nyctinomus cynocephalus* ranges north to at least the middle of the state; of the other five species no one occurs over all the Gulf Strip in the state; *Fiber rivalicius*, *Sciurus carolinensis fuliginosus*, and *Sylvilagus aquaticus littoralis* are found in the Gulf Strip only west of Mobile Bay, while *Peromyscus polionotus albifrons* and *Sylvilagus palustris palustris* occur only east of the bay.

It is therefore evident that no species or race of mammal is known to range over all the area of Upper Austral mapped for Alabama without at the same time occurring in parts of the Lower Austral; apparently not more than three species range over all the Lower Austral in the state and do not occur in the Upper Austral; and no form confined to the Gulf Strip ranges throughout that district in the state.

It is doubtful if additional knowledge about the distribution of the mammals of the state will increase the number of forms restricted to the particular zones. Some of the species now imperfectly known may possibly prove to be restricted in zonal distribution, but others now believed to be closely restricted will doubtless prove to occur also in the adjacent zones.

For the precise statement of the distribution in Alabama of all but a few mammals it will be necessary to give not only the life zone in which

[3] Specimens in Michigan Museum of Zoölogy.

[4] Howell, A. H., U. S. Dept. Agric., Bull. Biol. Surv., no. 38, pl. 1. 1911.

[5] Merriam, C. H., U. S. Dept. Agric., Div. Ornith. and Mamm., N. Amer. Fauna, no. 10, p. 14. 1895.

each species occurs, but also the part of the life zone or life zones. Geographic localities and features should be mentioned anyway in stating distribution and I can see no great gain, but much possible inaccuracy, in stating distribution in terms of life zones.

It is true that the ranges of species often closely coincide with certain natural features, vegetation, soil, altitude, topography, or climate, and it is often of great convenience to state distribution in terms of these, but these features often run across the life zones, as ordinarily mapped, instead of coinciding with them. In any case, the geographical limits for each species should be given also, so that if it is later found that the distribution of the species is not as closely correlated with the natural features as was supposed, the data of distribution are not thereby rendered worthless.

The common practice, which is followed in the paper under consideration, of stating, often without qualification, that a species belongs to a particular life zone, or, still worse, that it is characteristic of the life zone, when in fact it occurs in only a part of the area of the life zone, seems positively misleading.

The eastern part of the Lower Austral life zone, including all of the zone found in Alabama, was originally based on the Austroriparian faunal area.[6] There can be no question of the usefulness of recognizing such a faunal area. A number of characteristic species of mammals occur in the southeastern United States, and it is very convenient to be able to refer to these and to the general area which they occupy by a particular name. However, a careful study of the limits of the ranges of the various species in any group of animals or plants, such as the principal forest trees of Alabama,[7] will convince one that the majority of species do not find their limits of distribution at the same places; even though there may be a general correspondence between several species, sufficient in amount to justify the recognition of a faunal or floral district.

In the western parts of the United States, where climatic and physiographic boundaries are often very sharp, frequently a number of species do find their limits nearly at the same place, and here the boundaries of the faunal areas may be relatively very definite. But in a region with no sudden climatic or physiographic changes, as Alabama, it is futile to attempt to fix exact boundaries to the faunal areas. The Austroriparian and Carolinian faunas overlap over a relatively broad

[6] Merriam, C. H., U. S. Dept. Agric., Yearbook 1894, p. 214. 1895.
[7] Mohr, Charles, Contrib. U. S. Nat. Herb., vol. 6, pl. 1. 1901.

area and precise boundaries between the two can be designated only by arbitrary definition. To attempt an exact mapping of the boundaries between faunal areas, as is done in mapping the life zones of the state, is very likely to cause confusion, by giving the appearance of a precision in distribution which does not exist.

It may be pointed out here that the Austroriparian faunal area as generally considered[8] includes only the coastal plain of Alabama up to the "fall line," but the Lower Austral zone, as mapped by Howell, extends much north of this limit and includes a large area of hilly and mountainous country in the northern part of the state. This change is evidently considered necessary in order more exactly to indicate the limits of distribution of the species characteristic of the Lower Austral zone.

The life zones of Merriam are founded on the belief that there are zones of life extending transversely across the continent of North America, in the south as well as in the north. However, no species of mammal listed in this paper as characteristic of the Upper Austral zone of Alabama is listed by Hall and Grinnell[9] as characteristic of the corresponding zone in California. In the Lower Austral zone only one species, *Sigmodon hispidus* (represented by different subspecies), listed as characteristic of the zone, is found in both states.[10] In California, however, this species occupies only a small part of the Lower Austral zone, being restricted to the riparian associations along the lower Colorado River.[11] The same species (still another subspecies) is found in the Lower Tropical zone of Panama,[12] so it is not strictly a Lower Austral species.

In a tabulation of the genera of native land mammals which breed in Alabama and in the Upper and Lower Austral zones of California,[13] twelve genera which do not occur in the Austral zones of California are found in Alabama; twenty-three genera are found in these zones in California which do not occur in Alabama; and the following twenty-six genera are common to the two states in these zones:

[8] Merriam, C. H., Proc. Biol. Soc. Wash., vol. 7, p. 28. 1892.

[9] Hall, H. M. and J. Grinnell, Proc. Calif. Acad. Sci., ser. 4, vol. 9, pp. 49–51. 1919.

[10] Hall, H. M., and J. Grinnell, *op. cit.*, pp. 55–56.

[11] Grinnell, J., Univ. Calif. Publ. Zoöl., vol. 12, p. 230. 1914.

[12] Goldman, E. A., Smithsonian Misc. Coll., vol. 69, p. 28. 1920.

[13] Grinnell, J., Proc. Calif. Acad. Sci., ser. 4, vol. 3, pp. 265–390. 1913.

| | | |
|---|---|---|
| Sorex | Vulpes | Reithrodontomys |
| Myotis | Urocyon | Peromyscus |
| Pipistrellus | Procyon | Sigmodon |
| Eptesicus | Mustela | Neotoma |
| Nycteris | Spilogale | Fiber |
| Corynorhinus | Mephitis | Castor |
| Nyctinomus | Lutra | Sylvilagus |
| Ursus | Felis | Odocoileus |
| Canis | Lynx | |

Every one of the genera listed is wide-ranging, occurring in life zones either north or south of the Austral zones, and some of the genera occur on both sides of the Austral. The genera of mammals of California and Alabama thus show a high degree of dissimilarity, even when the two Austral life zones are considered together, and those genera which are found in both states are wide-ranging forms not closely restricted zonally.

The species of mammals in California and Alabama show still less similarity, only the following species of native land mammals being found breeding both in Alabama and in the Austral zones of California:

| | |
|---|---|
| Eptesicus fuscus | Sigmodon hispidus |
| Nycteris borealis | Fiber zibethicus |
| Urocyon cinereoargenteus | Castor canadensis |
| Mustela vison | Odocoileus virginianus |
| Lutra canadensis | |

Of these, *Eptesicus fuscus* is the only form represented in the two states by the same subspecies.

All the forms listed are wide-ranging and are not closely restricted as to life zones. *Sigmodon hispidus* ranges south to the Lower Tropical of Panama, and all the others are northern forms reaching at least as far north as the lower edge of the Boreal. Also, no one of the species listed seems to conform closely in range in both Alabama and California to either boundary, as mapped of either of the Austral zones.

I have previously pointed out[14] that although belts of life do occur in the northern part of North America and on mountains, yet the recognition of transcontinental zones of life in the southern part of the United States seems contrary to the facts of distribution. Certainly the evidence presented above shows that in mammals there are only slight faunal relationships between the parts of Alabama and California mapped respectively as the Upper and Lower Austral life zones. The

[14] Dice, L. R., Univ. Calif. Publ. Zoöl., vol. 16, p. 337. 1916.

use of life zones for the classification of the facts of distribution in this part of the country seems therefore, very unsatisfactory.

These conclusions do not affect the recognition of an Austral zoogeographic region, with which we are not here concerned. Zoogeographic regions are concerned not alone with present distribution but take into account centers of distribution and routes and times of dispersal. Many species or larger systematic groups which have had their origin within a zoogeographic district are likely to spread in time beyond the limits of the district. However, the chief value of life zones would seem to lie in their use in connection with present distribution as related to climatic barriers, and they cannot be considered as subdivisions of zoogeographic regions without bringing in a multitude of conflicting factors.

The greatest usefulness of the life zones proposed by Merriam should lie, not in their use for the statement or classification of animal and plant distribution, but in the explanation which they may give as to the factors limiting distribution.

The life zones of North America were founded by Merriam largely on the distribution of certain temperature factors in correlation with the distribution of faunal areas in the East and of life belts on the mountains of the West. The comparison of the distribution of climatic factors with the distribution of animals and plants is a valuable means of determining the climatic factors limiting distribution. Such comparisons, however, should not be confined alone to the sum of the temperatures over 43°F. (or 32°F.) for the year, and the average of the hottest six weeks of summer, but should include all the climatic factors which seem likely to have an influence on distribution. Among these may be mentioned maximum and minimum temperatures, average temperature of the coldest part of the year, length and temperature of the frostless season, rainfall, evaporation, humidity of the air, wind movement, soil moisture, and light intensity and duration. Charts comparing the distribution of life with the occurrence of soil types, of topography, of altitude, of vegetation types, of ecologic habitats, of local barriers, and with centers of dispersal would also be of value in this connection.

It has been pointed out by Livingston and Shreve[15] that the climatic controls of plant distribution are very complexly interrelated, and that a certain degree of one factor, such as temperature, which may limit

[15] Livingston, B. E., and Forrest Shreve, Carnegie Inst. Wash., Publ. 284, p. 390. 1921.

the distribution of a species in one place, may not be a limiting factor in places where another climatic factor, such as humidity, is different. The same thing is undoubtedly true of mammals and of animals in general.

Unfortunately, most maps of life zones that have been presented since Merriam's original paper[16] have apparently been based partly on temperature considerations, partly on faunal affinities, and partly on the distribution of particular species of animals and plants which have been taken as zone indicators. However, it is seldom that any statement is made as to how largely climatic data have been employed in the construction of these life zone maps and how much the maps are dependent upon faunal considerations, or upon certain biologic indicators. In the absence of these data no critical comparison can be made of the climatic conditions and the faunas or floras of the areas mapped. These maps, therefore, are practically useless in any critical attempt to determine the factors limiting either the distribution of particular forms or of larger groups.[17]

It is apparent that the life zones as mapped for Alabama are based to a considerable degree on the belief that the distribution of life must correspond with temperature belts, and it is further evident that in the absence of direct temperature data for parts of the state the limits of the several zones are based to a considerable extent on topographic contours.

Differences in temperature undoubtedly are present between the highlands and lowlands of Alabama, and there can be no doubt that temperature is often an extremely important factor in the limitation of distribution. In fact, it seems probable that temperature relationships of some kind limit the distribution, either to the north or to the south, of a number of species of mammals found in the state. But it is equally evident that factors other than temperature are the ones which form the limits to distribution of many species in Alabama.

Limitation as to ecologic habitat is probably the factor limiting the geographical distribution of some of the species listed as characteristic in Alabama of particular life zones. The absence from the lower country (Lower Austral) of species living chiefly among rocks, and the absence from the upper mountains (Upper Austral) of swamp and marsh forms cannot be due entirely to temperature differences between these places.

[16] Merriam, C. H., Nat. Geog. Mag., vol. 6, pl. 14. 1894.
[17] See Livingston and Shreve, *op. cit.*, pp. 528–529.

Mobile Bay and the Tennessee River apparently are each barriers to the distribution of certain species of mammals. Although the effects of these barriers and of topography and ecologic habitat are noted under the particular species concerned, no indication of the effects of these factors in limiting distribution is given, or perhaps could be given, on the life zone map.

The apparent belief that all the problems of distribution within a state are solved by the presentation of a life zone map is not likely to lead to progress in untangling the complex interrelationships of the numerous factors involved in the limitation of animal and plant distribution. It seems that many persons have taken too literally the optimistic statement of the founder of the life zone school that "in its broader aspects the study of the geographic distribution of life in North America is completed. The primary regions and their principal subdivisions have been defined and mapped, the problems involved in the control of distribution have been solved, and the laws themselves have been formulated."[18]

## SUMMARY

The distribution of the species of mammals in the State of Alabama is not well shown by the life zone map presented. Only a relatively small percentage of the species known from the state agree closely in distribution with the boundaries of the life zones as mapped; and the presentation of such a life zone map gives an appearance of finality and precision to the classification of distribution which the facts do not justify.

The recognition of transcontinental Upper Austral and Lower Austral zones wrongly represents the faunal relationships of the parts of these zones mapped in Alabama and California respectively.

It is highly desirable to compare, by charts or otherwise, climatic and other geographic features with the distribution of species, systematic and ecologic groups, and faunas and floras; but the basis for the chart or comparison should be clearly stated. By the omission of data as to the basis on which they are formed, most life zone maps fail to be of any value for the critical determination of the factors which control animal or plant distribution.

*Museum of Zoology, Ann Arbor, Michigan.*

[18] Merriam, C. H., U. S. Dept. Agric., Yearbook 1894, p. 214. 1895.

# JOSEPH D. MITCHELL

By Vernon Bailey

[*Plate 8*]

On February 27, 1922, Joseph D. Mitchell, 72 years of age, a member of the American Society of Mammalogists, died at his home in Victoria, Texas. Outside of his own state where he had served in the legislature and had a wide circle of friends he was well known to many of the working naturalists of the country, and especially to those of the United States Department of Agriculture. For many years he was officially connected with the Bureau of Entomology but his interests were too broad and his knowledge too full and rich to be confined to any one line of research. All out of doors was his field of interest; mammals, birds, reptiles, insects, and plants were his daily companions and their relations to man his constant study. In the Monthly News Letter of the Bureau of Entomology, Dr. L. O. Howard has compared him with John Muir and John Burroughs. He was a keen naturalist and only lacked their powers of interpretation to have fully taken his place in their class. His careful observations have helped to settle many vexed questions of the economic status of mammals, birds, reptiles, and insects and his accuracy and integrity have won the confidence of both naturalists and the people of his state.

Personally Mr. Mitchell was quiet and retiring, with little desire for wealth or fame. He published little and gave his information freely to all. He frequently sent to the Biological Survey important notes and good photographs of natural history subjects, and finally, after much urging, complied with my request for a photograph of himself. Tall, straight as an arrow, with a long beard and a frank, genial face, he was a striking and picturesque figure and seemed no older at seventy than when I first saw him some fifteen years ago. He was so full of sympathetic interest in all about him that he seemed not to grow old. In a long and useful life he was a valuable co-worker in scientific research and the fruits of his work and his wholesome influence will live and grow.

One of his previously unpublished notes on the little hydrophobia skunk, just as he sent it to me five years ago, is a good example of his careful observations. His conclusions may be fallible but his facts are first hand, carefully selected, and valuable. There are rare cases on record of death from hydrophobia following the bite of these little

JOSEPH D. MITCHELL
Photo. taken May 24, 1916

(Bailey: Joseph D. Mitchell.)

skunks, which would naturally convey the germ of the disease if they had it, but far more cases such as those noted by Mr. Mitchell where the bite has proved harmless.

*Biological Survey, Washington, D. C.*

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## "MEXICAN POLECAT," "HYDROPHOBIA CAT," SPILOGALE INDIANOLA, OF SOUTHERN TEXAS

By J. D. Mitchell

The common idea that the bite of this little skunk will give hydrophobia is erroneous. It is true, there is a time in its life, when it is mad, but not with rabies. During the mating season, the male sometimes has spells of "temporary insanity," and runs amuck. During these spells he travels usually in a gallop, and will attack anything in his path. Several times I have met one under these conditions, and have given him the road.

I have known four persons to be bitten by these little animals while under these mad fits. In every case they were sleeping in open camps, and moon was shining bright. Three of the cats were killed and the fourth was identified, but escaped after a second attack.

Number One.—A young lady, sleeping under a wagon in Jackson County, Texas, was bitten through the ear. She struck the cat several times with her hands before it let loose. During the commotion that followed her screams, it ran around in camp, showing a bold front to every one, until it was killed with an ax. It did not emit any musk.

Number Two.—My brother and I were sleeping near the shore of Lavaca Bay, Calhoun County, Texas, when he was bitten through the nose. He grabbed the cat with both hands and threw it some distance and it disappeared. In half an hour it returned and began biting at the blanket, which he had pulled over his head for protection. We tried to kill it with our boots, but it finally escaped. It emitted no musk.

Number Three.—A negro boy, sleeping in a cow camp, in Jackson County, Texas, was bitten through the lower lip. He knocked the cat loose with his hand it was promptly killed with a stick of wood. It emitted no musk.

Number Four.—A Mexican cow-hand, sleeping in the open prairie, in Jackson County, Texas, was bitten through the penis. He grabbed

the cat with both hands and ran screaming across the prairie. He covered about one hundred yards before we got to him. He had squeezed the cat to death. It emitted its musk.

I knew all four of these people for from ten to twenty-five years after their being bitten and no evil effects followed in any of the cases.

Sitting on the cow pen fence in Lavaca County, Texas, late one evening, waiting for the calves to finish sucking, before separating them from their mothers for the night, I observed one of these little cats galloping along the road, which passed directly by the pen, and not more than ten feet from where I was sitting. A gentle bull had composed himself in the middle of the road for the night. When the cat arrived in front of the bull, he raised his tail and challenged, by patting the ground with his fore feet and scratching or kicking the ground with his hind feet. The bull paid no attention to him. After the second challenge had been ignored, the cat ran up within three or four feet of the bull, twisted his body to a half circle, and threw a spray of musk full in the bull's face. The bull sprang up with a snort and moved towards the prairie, the cat galloped along the road and soon disappeared. The bull continued to sneeze and shake his head until I left for the house, and from the way he acted when I passed him, I believe he accused me of the insult.

Riding by one of those sand mounds made by the wind in dry seasons, in the northern edge of Calhoun County, Texas, I heard a whining noise of distress, and an examination among the high weeds and grass showed an inhabited wolf den and the noise was proceeding from it. With boot-heel and a skinning knife I soon broke the den back to its occupants. A bunch of wolf pups were huddled in the far end, and one of these cats had one of them by the ear and was vigorously shaking it; and the pup was making the noise I heard. Procuring a long "senna weed," I twisted it in the hair of the cat's belly and pulled him out; as soon as released he went back and again attacked the pup. I again pulled him out, and as he came to the opening I gave him a swing and threw him some distance out into the weeds. By beating the ground with the "senna weed" and shouting, I confused him, so that he either lost his direction or changed his mind, and went galloping off.

I then got out the pups and killed them. There were two sizes or litters, four of one and five of the other, four showed the marks of the cat's teeth.

Many cowboys, whites, negroes and Mexicans, have told me their observations on this audacious habit, of this otherwise timid little

animal. The general opinion was that they were afflicted with rabies, and they were always slaughtered without mercy. My opinion, from my experience and observation, does not agree with the rabid theory. I believe it is a species of violent frenzy, brought on by unsatisfied sexual desires, or by being whipped by a rival. All that were examined by myself or by others after death were males.

*Victoria, Texas.*

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## GENERAL NOTES

### THE VALUE OF MOLES

In 1909 we had at home a Dutch governess, Mlle. M. Schmitt, whose father was a nurseryman and flower gardener in Holland. His garden, she told us, was fenced with a deep dug wall. He trapped energetically till all the moles were killed. Shortly after this all his lilacs and other flowering bushes were blighted in spite of his best care. He sent specimens to the experts. They told him that the "trouble is *you have no moles*." He restored the moles and the blight disappeared. Personally I have no knowledge of this matter. I give it as it came to me. Possibly it may suggest some useful lines of investigation.—Ernest Thompson Seton, *Greenwich, Conn.*

### THE "UNPROVOKED" ATTACK BY A "BROWN" BEAR

In the August number of volume 3 of the Journal I have read with much interest the communication by Mr. Bonebrake describing the "unprovoked" attack by a "brown" bear, which was probably a species of grizzly. Mr. Bonebrake's description of the facts, so far as he states them, cannot be doubted, but it seems clear that his assertion that the attack was unprovoked is an error, and also that the actions of the bear might be interpreted differently from the impressions given by his account of the affair.

This bear, a female, had found and buried the quarters of a moose killed the preceding day in a thicket of willows so dense as to prevent its being seen from a distance of at least fifty yards. Mr. Bonebrake, walking fifty or sixty feet in advance of two companions who were followed by two dogs, was approaching the carcass. The bear suddenly appeared charging, not at Mr. Bonebrake who was ahead in the lead, but at his two companions and the dogs. The dogs rushed at the bear which chased each in turn, approaching when in a state of rage and excitement close to Mr. Bonebrake before seeing him and charging him.

I can find nothing in the description to indicate the direction from which the bear charged Mr. Bonebrake's companions, whether it was from that of the buried meat or from an angle where she might have seen Mr. Bonebrake before she did the others. Nothing is stated to show how close the bear must have approached in the thicket before it was possible for her to see any one of the party. No mention is made of any noise, either conversation or footsteps, that may have

been made to attract the attention of the bear before she could have seen any of those approaching. While Mr. Bonebrake states that the dogs did nothing to induce the attack, yet nothing is mentioned to show whether they were following closely at heel or whether they were moving about irregularly in the brush so that the bear might have detected their presence before that of the men. The fact that she directed her attention first, not to the man in the lead, but to those behind who were close to the dogs, would cause one experienced in the ways of bears to suspect that the presence of dogs had some influence on the action of the bear.

But the main conclusion emphasized is: "that this attack was entirely unprovoked." This is completely contrary to the evidence given. The bear had appropriated the meat of the moose and, as is the habit of these bears, she was near it guarding it. She heard or saw intruders approaching directly toward her property. Experience had taught her that her buried meat must be vigilantly guarded against wolves, wolverines, lynxes, foxes, ravens, eagles, hawks, jays, and small mammals. Immediately she becomes aware of the approach of any intruder she charges to drive it away. In this case she was in the position of the man attacking thieves who had entered his house for purposes of robbery. Her provocation for the charge is clear.

In Alaska I have watched for several hours a female bear burying the carcasses of sheep, feeding on them at intervals and remaining near alertly and fiercely guarding them. I have observed her rush in the direction of a suspected intruder. No animal or bird could possibly have approached without being charged. I have also personally observed the action of a bear when approaching it accompanied by a dog. I have collected reliable evidence of the attacks of bears on men who when accompanied by dogs were approaching a carcass which the bear was guarding. In such cases the bears have been led to charge by the presence of dogs, probably believing them to be wolves or foxes coming to steal the meat. Yet there are several cases, perhaps reliable, where men, unaccompanied by dogs, have been charged by a bear which was guarding a carcass they were approaching. But could any observer assert that such attacks were unprovoked? All that could be maintained would be that the provocation on the part of the man was unintentional.—CHARLES SHELDON, *Washington, D. C.*

## THE "UNPROVOKED" ATTACK BY A BEAR

The title of Mr. A. C. Bonebrake's account of the killing of an Alaska brown bear, printed on page 185 of the August, 1922, issue of the "Journal," seems wholly misleading. His emphatic statement that the attack by the bear was quite unprovoked is not borne out by what he tells us. He describes the advance of men and dogs to take away food found by, and so in possession of, a female bear that was guarding it.

The mildest mannered domestic dog does not submit to having food taken from it by a stranger without making some protest; and, if it is a question of taking food from her young, she will fight in their behalf, except against someone in whom she has confidence.

We know little about the mental reactions of wild animals but it is certain that they respond to the stimuli of food, sex and fear. It is recognized that at given

seasons the sex impulse often conquers the fear impulse, and, also, that under certain conditions self-protection calls for fighting rather than for flight. Probably both impulses acted on this bear. She was protecting her young and its subsistence, and she was fighting to retain her food. Can we imagine acts more natural?

The full and frank account of the circumstances given by Mr. Bonebrake will lead many to feel that the bear had strong provocation to attack those who were threatening her food, and that the conclusion expressed in the title of the account and in its last paragraph, is unwarranted.—Geo. Bird Grinnell, *New York City.*

### RANCHER KILLED BY GRIZZLY BEAR IN MONTANA

Joseph Duret owned a ranch on Slough Creek five miles north of Yellowstone Park, and had traps out for bears. On June 12, 1922, after visiting his traps, he returned to his ranch and told his wife that he had caught a large grizzly. He took his rifle and left about 10 a.m. Nothing being heard of him, search was started that afternoon and continued the next day. On the 13th, at 8 p.m., his body, badly torn and mangled, was found; apparently he had crawled a mile and a half after escaping from the bear. The trap had been set one and a half miles outside the Park, and there were many signs of a severe struggle. One cartridge had been fired from the rifle, a Winchester. It is assumed that the enraged bear made a lunge, either before or after the shot, broke the chain of the trap, sprang on Duret, and mangled him badly. There is nothing to show that Duret's shot wounded the bear, and it may have missed altogether. The bear escaped, carrying the heavy trap with him, although efforts have been made to find and kill him.

While this is a distressing occurrence it should be given the widest publicity possible for people must learn that bears are dangerous animals if molested. It does not, however, alter my contention that even grizzlies are harmless if let alone.—M. P. Skinner, *Park Naturalist, Yellowstone Park, Wyo.*

### BEARS EAT CASCARA BERRIES

In the coast country of Oregon and northern California the pigeon berry, or cascara (*Rhamnus purshiana*), grows to a good sized tree and late in summer is often loaded with large, purple berries, a favorite food of band-tailed pigeons. They are sweet and juicy, with a flavor neither wholly agreeable nor wholly unpleasant to my taste, but they seem to be palatable to many birds and mammals and even when salal, salmon berries and blueberries are ripe the bears occasionally eat them.

In the fall of 1909, near Coos Bay, Oregon, while following a dim trail through the forest, I came to a small cascara tree, much torn, scratched, and broken, with the top branches pulled down and turned in, most of the berries gone, and bear trails leading to and from it through the tangled bushes. A tree of that size should have had a half bushel of berries but there were only a few handfuls left that had escaped the bear's vigorous search.

The medicinal properties of the berries had evidently begun to take effect before the bear got down from the tree and the trail leading away through the bushes as far as I followed it demonstrated their cathartic efficiency. There

was no question of what the bear had been eating, for skins and seeds of the berries, and even some whole berries that had been hurriedly swallowed without being crushed were strewn along the trail. The bear had evidently eaten in a hurry and gone away in a hurry.

I have often wondered if that old bear knew that he was taking medicine or whether he just took it because he liked it. Had he been living too long on tanbark oak acorns and felt the need of a change of diet, or did he just make a pig of himself, and get an over-dose of these sweet berries?—VERNON BAILEY, *Biological Survey, Washington, D. C.*

### CANIS GIGAS IN THE BLUE MOUNTAINS OF OREGON

On November 2, 1915, a large male of the Cascade timber wolf (*Canis gigas*) was shot by Mr. H. W. Fisk in Logan Valley, Grant County, Oregon. The skin, which was of the tawny type, was presented to the State Game Commission during December, 1915, where it was examined by the writer. Logan Valley is a small mountain valley at about 5000 feet altitude in the Blue Mountains, and is surrounded by heavy forests of almost a clear stand of yellow pine. As this is the only known occurrence of this wolf east of the Cascade Mountains in Oregon I thought it well to place it on record. *Canis gigas* at present ranges from Indian Creek in Jackson County, Oregon, north to the Clackamas River in the county of the same name, and so far as known only along the west slope of the Cascade Mountains. There are probably not over one hundred of these animals in the state today.—STANLEY G. JEWETT, *Portland, Oregon.*

### CACOMIXTL IN ALABAMA

On April 16, 1922, at Matthews, Montgomery County, Alabama, a Texas bassaris (*Bassariscus astutus flavus*) was shot in the barnyard of a tenant. The animal was making an effort to catch chickens. It was brought into Montgomery to the conservation commissioner, who presented it to the Alabama State Department of Archives and History to be mounted for the State Museum.

The animal measures 16½ inches over the body, and has a 19 inch tail. It has a good coat of fur and the coloring is pronounced. So far as known, this is the first positive identification of the animal in this state, though a negro coon-hunter reported catching one, which he minutely described as "a 99 year old weasel with rings on his tail," in 1915. The report was made to Dr. Porter Bibb and the writer, and at that time we suspected that he referred to the cacomixtl.

The specimen taken this month has been positively identified by Doctor Bibb, though some have thought it a marten from the north.—PETER A. BRANNON, *Montgomery, Alabama.*

### A RECENT REPORT OF THE WOLVERENE IN MINNESOTA

Dr. H. H. T. Jackson's note in the February, 1922, number of the Journal, with regard to the wolverene killed in Itasca County, Minnesota, January 11, 1899, interested me. I have from time to time endeavored to obtain information as to the past history of the wolverene in Minnesota but without much success. A year ago, however, in reply to my inquiry I received from a fur trader of long

experience in northern Minnesota, a letter under date of March 10, 1921, from which I quote the following:

"The wolverene is very scarce. For 30 years I have been traveling around St. Louis and Lake counties and along the Minnesota border in Canada, buying furs and I would not average more than one wolverine pelt during the season. It is 3 years since I bought any. They are not as plentiful as they were 20 years ago." Then, regarding a skin which he had secured: "I bought it in the northern part of St. Louis County. It was a green pelt (recently caught). I should think it was caught right there at the border."

This wolverene, therefore, was taken in 1918; it would appear as though this animal may hardly yet be reckoned as a completely extirpated species of extreme northern Minnesota and the adjoining border of Canada.—CHARLES EUGENE JOHNSON, *University of Kansas, Lawrence, Kan.*

### THE WEST INDIAN SEAL

Among the seals now reduced to very limited numbers and known to breed in a single locality only, is the West Indian species *Monachus tropicalis*. This seal, formerly widely distributed in the West Indies, has for the past forty years been known to breed only on the Triangle Islets in the Gulf of Campeachy.

A specimen was killed on March 15, 1922, near Key West, Florida, where it was identified by Mr. L. L. Mowbray, formerly of the Aquarium staff. The Aquarium has not been able to secure a specimen of the West Indian seal since 1909. It has not been recorded from Florida waters since 1906.

Unfortunately the reappearance of a rare seal is generally made known by its slaughter.—C. H. TOWNSEND, *The Aquarium, New York City.*

### AN EXTENSION OF THE RANGE OF THE MUSKRAT IN CALIFORNIA

Recent invasion of new areas by well-known forms of the animal kingdom, whether by process of natural range extension or by the agency of man, and their successful or unsuccessful occupation of these new territories, must ever be a matter of interest to the working zoölogist. Too often the data relative to an invasion are obscured by time before sufficiently palpable change is effected in the economic or ecological status of the region to direct attention to the new situation. There are hundreds, if not thousands, of examples in the zoölogical history of the world of this unfortunate dearth of information relative to recent intrusions of this character. The introduction of the opossum into California will serve as an excellent illustration, to cite only one instance among many. The results of this importation—obviously the work of man—are already becoming a matter of keen ecologic interest in the state, with distinct possibilities of their developing into an economic problem of importance. Yet the history of this importation is already dimmed by the years, despite the comparatively short zoölogical history, in the limited and recorded sense, of the California area.

The possibility (I might almost say probability) that the hitherto unrecorded presence of *Ondatra zibethica* west of the Sierra Nevada Range will, in years to come, prove of economic importance in the southern San Joaquin Valley, must serve as an explanation for the present presentation of the somewhat fragmentary records and conclusions set forth herewith.

On June 4, 1920, Mr. A. J. van Rossem and the writer found the skin of a muskrat (No. HX 4, collection of Donald R. Dickey) tacked to the side of a shack occupied by Charles E. Sawyer, on the west shore of Buena Vista Lake, Kern County, California. On inquiry it was learned that the specimen had been "shot in a nearby irrigation canal in February, 1920, by Thomas Kelly" (fide Sawyer). The fact that the skin gave unmistakable evidence of having been tacked to this particular spot when green, and the further fact that the skin had no particular interest for Mr. Sawyer, who had been entirely familiar with the genus in the East, and therefore accepted its capture here as a commonplace matter, lend color and certainty to the data furnished me.

The skull of the specimen had of course been destroyed, but the skin exhibited distinct differences from the considerable series of *Ondatra zibethica pallida* in the collection of the author. The skin in question was therefore submitted to the Museum of Vertebrate Zoölogy, of the University of California, for identification. Entirely satisfactory allocation is difficult with such fragmentary material, but Dr. Joseph Grinnell unqualifiedly pronounced it *Ondatra zibethica mergens*, "by skin characters."

Further data was furnished by C. E. Whitney, a familiar figure in the resident shooting and boating life of the lake. In conversation with van Rossem, during the summer of 1921, Mr. Whitney stated that muskrats were a rare but established part of the lacustrine life of the region. He had seen two individuals during that year, but had taken no specimens.

Based on the analogous evidence of the resident forms of other species in the region, *Ondatra zibethica pallida* would have been expected, if the species had been an inherent part of the fauna of the area. That the more valuable fur form *mergens* is the one actually found, instead of the more likely *pallida*, strongly indicates human agency and artificial transportation of the species to this region. Experience with the species in other sections—notably in the Danube and Elbe watersheds of central Europe, where the status quo of nature has been seriously upset by the introduction of muskrats (Ahrens, Journ. of Mam., vol. 2, 1921, pp. 236–237)—will focus the attention of students on the developments in the San Joaquin area. Whether these developments will furnish a fur boon to local trappers, or a dangerous menace to irrigation interests, is a story for the future to unfold.—Donald R. Dickey, *Pasadena, California.*

### ABNORMAL HAIRY GROWTHS UPON THE TAILS OF THE HETEROMYIDÆ

It is a quite well-known fact that the caudal vertebræ of the pocket mice (*Perognathus*) are rather insecurely attached to their neighbors (see Sumner and Collins, Autotomy of the Tail in Rodents, Biol. Bull., xxxiv, 1918, pp. 1–6), and that when they are amputated, which operation is sometimes assisted by the animal when captured by this member, an abnormal growth of hair often results. This has been attributed to an effort on the part of Nature to replace the pencil that was on the original tip. If the tails of the pocket rats (*Dipodomys*) are more fragile than those of the average rodents, it can be but to a slight degree, yet the abnormal pencils upon injured tails are just as usual as in the case of the pocket mice.

Among a couple of hundred or more *Dipodomys* trapped by the writer have been many with damaged tails. Detailed descriptions of but a few of these have

been kept, for this condition is quite common, but it is my recollection (substantiated by those skins now available to me), that, if the amputation is near the tip, the new growth of hair will be of the same color as the old, and but slightly heavier and coarser. However, it seems that when an animal of this genus loses more than a third or half of its tail, a large tuft of coarse, *white* hairs, 25 to 40 millimeters long, usually grows upon the injured end. I do not remember ever to have caught any *Perognathus* with more than half of the tail gone, except a few individuals which showed that the injury had been only recently sustained; this in spite of the fact that the vertebræ are so loosely connected. However, many are caught with about one-third of the tail gone, and so far as I have observed, the coloration of the new growth of terminal pencil is always the same as that of the old. I have now had for thirteen months, a male *Perognathus fallax pallidus* whose entire tail was severed by the trap in which it was caught, leaving a stump less than half an inch in length. This animal has had no food during its captivity save dry, rolled oats, and is now in the best of health, but no hair has grown upon the stump.

I have before me a male *Perognathus penicillatus angustirostris*, number 1203 of my collection, taken at Thermal, Riverside County, California, on January 29, 1918. The length of tail was apparently normal, being 107 mm. in the flesh and 104 mm. in the dried skin. On the left side of the tail, at approximately 31 mm. from the base, there is a dense tuft of a hundred or more rather coarse, pure white hairs averaging 20 mm. in length. When skinning the animal I noted that there was an injury to the vertebra beneath this tuft, as the bone had enlarged at this point and had apparently become coalesced with its neighbor.

Also worthy of note is an adult female *Dipodomys merriami simiolus* taken by the writer in the Palm Springs district of Riverside County, October 16, 1921. This animal has a tail of 139 mm., and 60 mm. from the tip is a rather sparse dorsal tuft of coarse, white hairs 20 to 25 mm. long. Immediately posterior to this begins the pencil of normal color, but of unusual luxuriance in its anterior portion.

The simple explanation of these phenomena seems to be that as the tails of this family of rodents play an important rôle as rudder and balance during the long leaps of the animal, Nature endeavors to atone for the decreased length of an amputated tail by garnishing it with an overdose of pencil. Well and good, but the body cells are evidently unable to distinguish between the removal of a part of the tail, and an injury to one of its vertebræ, and the latter brings about a similar, though modified, result.

The more technical explanation should be that we are justified in presuming that the hind legs of the *Heteromyidæ* have the greatest evolutional velocity of any part of the body of the animal. They are in a plastic state of development and if the variational direction is towards an increase of size and specialization, as seems highly probable, they will continue to develop at the expense of the forelegs (as in the marsupial kangaroos). The growth of the tail is at least indirectly dependent upon that of the hind legs, for the more powerful the legs and the longer the leaps, the greater is the part of balancer and rudder played by the tail. Hence, the tail should share in the evolutional velocity of the legs, and it is known that characters with the greatest evolutional velocity are more readily affected by stimuli of all kinds, including those of a pathological nature. The

conclusion is that the tails of the heteromyids are in a state of genetic unrest, and that they are therefore quite susceptible to unusual conditions, which, in this case, consist of injuries to, or a diseased state of, the caudal vertebræ. So far as I know, the tails of all mammals are incapable of autotomy. Hence, the logical manifestation of unusual stimuli is the formation of abnormal hairy growths.

Some there are who will object to this interpretation on the grounds that this extra growth of hair is natural on a tail that is normally penicillate, and that the condition is analogous to the patches of white hair upon the backs of saddle-galled horses. Possibly, but I hardly think so, for if that line of reasoning were correct, then we should find a patch of *short* white hairs, no longer than their neighbors, upon an injured tail. It is perfectly true that *Zapus*, say, does not have abnormal hairy growths upon its tail, so far as we know, and it would be astonishing if it ever did, for before this could occur, the animal would probably first have to acquire a factor for normal penicillation of the tail. A significant fact in this contention is that I have never heard of a squirrel with hairy tufts of unusual length upon any part of the tail, and to sustain the above objections to the theory which I have presented, this would have to occur to a greater degree in that family than with the heteromyids. This is as might be expected because, although the caudal members of certain squirrels may tend to vary towards an increase of bushiness, the basic structure (somatic cells) does not seem to be in an active state of evolution, so far as can be judged.—A. Brazier Howell, *Pasadena, California.*

### RATE OF REPRODUCTION IN CITELLUS BEECHEYI

An observation has recently been called to our attention which may be of interest to some of the readers of the Journal, especially to those who are concerned with the rate of reproduction in mammals as a result of their numbers having been depleted by concerted activity in their control. In Tulare County, California, consistent operations in rodent control have been carried on with poison and carbon bisulfid gas against the California digger ground squirrel, *Citellus beecheyi beecheyi*. This spring an opportunity was given one of our field men to kill a number of these prior to the birth of the young. Out of 111 individuals killed, 86 were females and it was found that these females were carrying embryos in all stages of development. Out of the entire 86 there were taken 846 embryos. It was found that on areas where control operations had been carried on for two years or longer, thereby allowing for an increase in food supply and at the same time decreasing the numbers dependent on a certain area for food, the litters were uniformly larger than on areas where the work had either just been started this year or had been in full force for eight or nine months. While this evidence is not absolute in any way, nevertheless it would point toward an endeavor on the part of the species to come back to the larger numbers that had normally been supported on the particular piece of land.—W. C. Jacobsen, *State Department of Agriculture, Sacramento, Calif.*

### A METHOD EMPLOYED BY A BLACK SQUIRREL IN CARRYING ITS YOUNG

Mammals which carry their young by grasping the back, or nape, usually allow the young to hang in a suspended position. Although this method does not interfere with locomotion in the case of cats and dogs, some variation would seem to be necessary in the case of squirrels because of their comparatively short legs and entirely different body carriage. The gymnastics entailed by their arboreal existence would be greatly impeded, especially if well-developed young were being moved.

I have made observations which show that although the part the parent takes in conveyance is the same as generally practised, the young aids the parent by encircling its hind legs about the neck of the latter. The accompanying sketch illustrates the position of the young on the under side of the parent's neck. I observed this interesting mode of carrying the young while watching a black

squirrel (*Sciurus carolinensis leucotis*) transfer its offspring from one nest to another in High Park, Toronto. The distance between the two nests was about forty yards and it was necessary for the parent to come to the ground in crossing a small ravine. The parent's burden did not hinder progress either in the trees or on the ground.—L. L. SNYDER, *Royal Ontario Museum of Zoology, Toronto, Ont.*

### BEAVER INTRODUCED IN VERMONT

Although there are still traces of the animals' work in "beaver meaders," the native beavers have been extinct in Vermont for a half century and probably more. A colony of six beavers, taken from the Adirondacks on permission of the proper authorities, was introduced in Vermont in October, 1921. The scene selected for the planting of the colony was a big meadow swale in Stamford,

Bennington County, in the southern part of the state. The Vermont game laws give the animals rigid protection. They adapted themselves readily to their new environment and began dam building within two weeks.—GEORGE L. KIRK, *Rutland, Vt.*

### PERIODICAL EMIGRATIONS OF MAMMALS

That certain of our small mammals are subject to periodical movements amounting to short emigrations is well known to most of our observers, but just to what extent this shifting of residence takes place or what species are affected is as yet but little known; and owing to the nature of the movements reliable data are difficult to secure. The few notes that I have on the subject are offered in hopes of calling attention and, perhaps, stimulating further investigation.

It is not difficult to picture the little chief hare (*Ochotona*) as resident, in its home rock slide, from generation to generation. The statement that it would become so erratic as to undertake a voyage through perhaps several miles of unbroken timber, in search of new homes might seem to border on nature faking. However, I have several times happened on such venturesome picas in the mountains of southern Colorado, miles from anything that could be regarded as their natural habitat, which is normally confined to rock slides in the higher altitudes. Except when I have met with them during their fall wanderings, I can not, at this writing, recall that I have ever seen them below timber line in Colorado. The strays above mentioned might have been 1000 feet or more below. I think that the Colorado wanderers were all seen in October.

In the Powder River Mountains of eastern Oregon I found a race of *Ochotona* (*schisticeps?*) in the rock slides at 4500 feet to the tops of the range. Frequently these rock slides differed from the homes of the Colorado picas in being surrounded by timber—pine and fir. During October of each year I have met with a few picas a mile or more from the slides. A pair which took up a winter residence in a slab pile at my camp on East Eagle Creek were about two miles from the nearest colony and fully 1500 feet lower in altitude. They were seemingly contented in early May and I had hopes of seeing a colony started there when they disappeared. A weasel that was seen about the time of their disappearance might have given testimony as to where they went. I have never known colonies to be started in these abnormal surroundings. Whenever picas were found away from the slides they either moved on or were destroyed by predatory animals.

In late March I once met with a muskrat on a sage-grown mesa, a full mile from the nearest stream and fifteen miles from the nearest water toward which he was journeying.

Along the foothills bordering the eastern slopes of the Blue Mountains of eastern Oregon, yellow-bellied woodchucks (*Marmota flaviventer*) are common in the rocky ledges. Just before the period of hibernation, which begins the last of July, they may be seen several miles from the nearest ledge, voyaging across the sage flats toward some rocky outcrop that might offer shelter.

By far the most interesting "drifter' is the western bushy-tailed woodrat (*Neotoma cinerea occidentalis*). There would seem to be an extensive and regular movement of this species beginning each year in early July and extending over a period of about five weeks. In 1912 I trapped 25 rats in my barn in some three weeks and then resigned in favor of my son, H. E. Anthony, who soon extended

the record to 40. At no time was there evidence of more than two or three rats on the place and after the last was captured, some time in August, I think there were none seen until the following July. In later years I noticed one or two woodrats at about the same date and a steady movement was noted until about the middle of August. If a pair were trapped it was seldom over 24 hours before more appeared, but it was seldom, if ever, that we were annoyed by their depredations after their movements had ceased in August.

At the time these movements take place, food is still to be had in its usual abundance and the mating season has long since passed. It would seem to be chiefly an instinct to seek new habitats before winter shuts them in, and one which serves as a check on consanguinity and its evil effects.—A. W. ANTHONY, *Museum of Natural History, San Diego, Calif.*

### THE RED BAT IN BERMUDA

Thanks to the kind interest of Prof. E. L. Mark, I have lately received the skin of a male red bat (*Nycteris borealis*) that was captured several years ago in Bermuda. The specimen has now been presented to the Museum of Comparative Zoölogy. Although additional particulars regarding it are not obtainable, it seems probable that it was one taken at St. George's about 1909, by Mr. L. L. Mowbray, who in response to an inquiry from Doctor Mark, writes: "Bats are by no means rare in Bermuda; I have seen one or two in Pembroke almost every year. I have seen them in the cave district but never in the caves. That species seems to cling to the cedars in the fork of the branch; they are of a gray-brown color and resemble the bark in color very closely." Mr. Mowbray's brief description seems to fit the hoary bat (*Nycteris cinereus*), a species which both Hurdis and Verrill have reported from Bermuda. The latter also records the silver-haired bat (*Lasionycteris noctivagans*) from these islands. The occurrence of the red bat is doubly interesting, not only on account of the locality, but because, like the two other species mentioned, it is a tree-inhabiting bat and like them probably makes a much more extended and regular migration southward in fall than do our cave-haunting species, whose seasonal withdrawal is probably of a much more local nature.

The frequent occurrence of the bats just mentioned in the Bermudas, indicates that these species must make extended journeys over water in the course of their migrations, and no doubt are frequently carried far from their course. Of interest in the same connection is the recent note by Mr. Oldfield Thomas (this journal, vol. 2, p. 167, 1921) of a "considerable flock" of red and silver-haired bats which caught up with and settled on a ship some twenty miles off the coast of North Carolina, on September 3, 1920. I have a newspaper clipping concerning a somewhat similar occurrence, related to the Baltimore *Sun* by Captain Harland of the British steamer HARDANGER. The date was apparently about the first week in September, 1902. On the night in question the vessel encountered a large migration of bats when some ten miles off the Delaware. Their attempts to alight evidently led to the belief that the bats were attacking the sailors, but eventually the vessel left them. The next morning a number of the bats were captured on the deck. During the following night a smaller visitation of bats occurred while the vessel was in Chesapeake Bay. I was unsuccessful in my attempts to learn more definitely what species of bats these were.—GLOVER M. ALLEN, *Cambridge, Mass.*

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